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AEROSPACE MEDICINE AND BIOLOGY

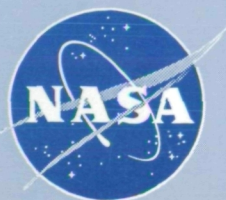
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January 1995

AEROSPACE MEDICINE AND BIOLOGY

A CONTINUING BIBLIOGRAPHY WITH INDEXES



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INTRODUCTION

This issue of *Aerospace Medicine and Biology* (NASA SP-7011) lists 122 reports, articles, and other documents recently announced in the NASA STI Database. The first issue of *Aerospace Medicine and Biology* was published in July 1964.

Accession numbers cited in this issue include:

<i>Scientific and Technical Aerospace Reports (STAR)</i> (N-10000 Series)	N95-10001 — N95-11697
Open Literature (A-60000 Series)	A95-60001 — A95-60779

In its subject coverage, *Aerospace Medicine and Biology* concentrates on the biological, physiological, psychological, and environmental effects to which humans are subjected during and following simulated or actual flight in the Earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. Applied research receives the most emphasis, but references to fundamental studies and theoretical principles related to experimental development also qualify for inclusion.

Each entry in the publication consists of a standard bibliographic citation accompanied, in most cases, by an abstract. The listing of the entries is arranged by *STAR* categories 51 through 55, the Life Sciences division. The citations include the original accession numbers from the NASA STI Database.

Seven indexes—subject, personal author, corporate source, foreign technology, contract number, report number, and accession number—are included.

A cumulative index for 1995 will be published in early 1996.

The NASA CASI price code table, addresses of organizations, and document availability information are located at the back of this issue.

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Category 54	Man/System Technology and Life Support Includes human engineering; biotechnology; and space suits and protective clothing.	22
Category 55	Space Biology Includes exobiology; planetary biology; and extraterrestrial life.	N.A.

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NASA SPONSORED
ON MICROFICHE

This paper reports the results of a pilot study in which a 240-gram rat was implanted for 41 days with biotelemetry devices weighing a total of 36 gm (18 cc). The implanted animal showed no differences in weight gain, food and water consumption, and postnecropsy organ weights when compared to both an unoperated control animal and an animal that underwent surgery but did not receive an implant. The implanted animal also had temperature and activity rhythms similar to those reported using much smaller implants. Thus, this pilot study showed that a 240-gm rat could be implanted with biotelemetry devices weighing nearly 15 percent of body weight without significant changes in health or behavior. A larger study involving more animals and similar implant sizes is recommended.

ACCESSION NUMBER	→	A95-60650	
TITLE	→	BASIC ASSUMPTIONS AND COMPARISON OF THREE GRAVITROPIC RESPONSE MODELS	
AUTHOR	→	A. STOCKUS Inst. of Botany, Vilnius, Lithuania	Advances in ← AUTHORS' AFFILIATION
JOURNAL TITLE	→	Space Research (ISSN 0273-1177) vol. 14, no. 8 August 1994	← PUBLICATION DATE
		p. (8)145-(8)148 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Wash., DC, Aug. 28-Sep. 5, 1992	
REPORT NUMBER	→	(ISBN 0-08-042485-6) Copyright	

Three systemic models of gravitropic response were compared by fitting different experimental data. Results indicate that fits improve with the inclusion of diageotropic component into formulas that allow to model plagiotropic orientation. More realistic simulation of gravitropic bending along an axial organ does not improve the fit but multiplies the number of parameters and causes correlation among them. However, such a model seems to have more possibilities for further improvement.

Author (Herner)

AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 397)

January 1995

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LIFE SCIENCES (GENERAL)

A95-60141* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

MORPHOLOGICAL AND BIOCHEMICAL EXAMINATION OF COSMOS 1887 RAT HEART TISSUE. PART 1: ULTRASTRUCTURE

D. E. PHILPOTT NASA, Ames Research Center, Moffett Field, CA, US, I. A. POPOVA Inst. of Biomedical Problems, Moscow, Russia, K. KATO NASA, Ames Research Center, Moffett Field, CA, US, J. STEVENSON NASA, Ames Research Center, Moffett Field, CA, US, J. MIQUEL Linus Pauling Inst. of Science and Medicine, Palo Alto, CA, US, and W. SAPP Tuskegee Univ., Tuskegee, AL, US The FASEB Journal (ISSN 0892-6638) vol. 4, no. 1 January 1990 p. 73-78 (HTN-94-00444) Copyright

Morphological changes were observed in the left ventricle of rat heart tissue from animals flown on the Cosmos 1887 biosatellite for 12.5 days. These tissues were compared to the synchronous and vivarium control hearts. While many normal myofibrils were observed, others exhibited ultrastructural alterations, i.e., damaged and irregular-shaped mitochondria and generalized myofibrillar edema. Analysis of variance (ANOVA) of the volume density data revealed a statistically significant increase in glycogen and a significant decrease in mitochondria compared to the synchronous and vivarium controls. Point counting indicated an increase in lipid and myeloid bodies and a decrease in microtubules, but these changes were not statistically significant. In addition, the flight animals exhibited some patchy loss of protofibrils (actin and myosin filaments) and some abnormal supercontracted myofibrils that were not seen in the controls. This study was undertaken to gain insight into the mechanistic aspects of cardiac changes in both animals and human beings as a consequence of space travel. Cardiac hypotrophy and fluid shifts have been observed after actual or simulated weightlessness and raise concerns about the functioning of the heart and circulatory system during and after travel in space.

Author (Herner)

A95-60153* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

ULTRASTRUCTURAL AND CELLULAR MECHANISMS IN MYOCARDIAL DECONDITIONING IN WEIGHTLESSNESS

DELBERT E. PHILPOTT NASA, Ames Research Center, Moffett Field, Calif., US, KATHARINE KATO NASA, Ames Research Center, Moffett Field, Calif., US, and JAIME MIQUEL NASA, Ames Research Center, Moffett Field, Calif., US Advances in Space Biology and Medicine vol. 2 1992 p. 83-112 (ISBN 1-55938-409-3; HTN-94-00464) Copyright

The cardiovascular deconditioning that has been shown to result from immobilization on earth and in the microgravity environment during spaceflight is considered. The major interests to future long-term spaceflight are the determination of the specific factors causing myocardial deconditioning, the irreversibility/reversibility of the changes, and preventative/treatment methods for this decondi-

tioning process. The results of earlier animal studies designed to determine the effects of immobilization on myocardial function demonstrate that both ultrastructural and functional changes occur during test periods ranging from 14 days to 6 months. Based on such results and the need for a more precise understanding of the structural and biochemical mechanisms leading to these effects, an experiment was designed for use in future studies. The results of the Cosmos 1887 and 2044 flights as well as their comparison and analysis indicate that significant differences exist between simulated and actual spaceflight subjects. Spaceflight subjects demonstrate greater changes than tail-suspended subjects. More spaceflight studies will be necessary to gain a greater understanding of the basic mechanism behind myocardial deconditioning resulting from spaceflight and the most effective methods to be utilized in its prevention and treatment.

Herner

A95-60154* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

PRESENCE OF METHYL STEROL AND BACTERIOHOPAN-EPOLYOL IN AN OUTER-MEMBRANE PREPARATION FROM METHYLOCOCCUS CAPSULATUS (BATH)

LINDA L. JAHNKE NASA, Ames Research Center, Moffett Field, CA, US, HELGA STAN-LOTTER Univ. of Vienna, Vienna, Austria, KATHARINE KATO NASA, Ames Research Center, Moffett Field, CA, US, and LAWRENCE I. HOCHSTEIN NASA, Ames Research Center, Moffett Field, CA, US Journal of General Microbiology vol. 138 1992 p. 1759-1766 (HTN-94-00465) Copyright

Cytoplasmic/intracytoplasmic and outer membrane preparations of *Methylococcus capsulatus* (Bath) were isolated by sucrose density gradient centrifugation of a total membrane fraction prepared by disruption using a French pressure cell. The cytoplasmic and/or intracytoplasmic membrane fraction consisted of two distinct bands, Ia and Ib (buoyant densities 1.16 and 1.18 g/ml (exp -1), respectively) that together contained 57% of the protein, 68% of the phospholipid, 73% of the ubiquinone and 89% of the CN-sensitive NADH oxidase activity. The only apparent difference between these two cytoplasmic bands was a much higher phospholipid content for Ia. The outer membrane fraction (buoyant density 1.23-1.24 g/ml (exp -1)) contained 60% of the lipopolysaccharide-associated, beta-hydroxy palmitic acid, 74% of the methylsterol, and 66% of the bacteriohopanepolyol (BHP); phospholipid to methyl sterol or BHP ratios were 6:1. Methanol dehydrogenase activity and a c-type cytochrome were also present in this outer membrane fraction. Phospholipase A activity was present in both the cytoplasmic membrane and outer membrane fractions. The unique distribution of cyclic triterpenes may reflect a specific role in conferring outer membrane stability in this methanotrophic bacterium.

Author (Herner)

A95-60632* National Aeronautics and Space Administration, Washington, DC.

LIFE SCIENCES AND SPACE RESEARCH 25 (1). GRAVITATIONAL BIOLOGY; INTERDISCIPLINARY SCIENTIFIC COMMISSION F OF THE COSPAR PLENARY MEETING, 29TH, WASHINGTON, DC, AUG. 28-SEP. 5, 1992

A. COGOLI, editor ETH Technopark, Zurich, Switzerland, M. COGOLI-GREUTER, editor ETH Technopark, Zurich, Switzerland,

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R. GRUENER, editor Univ. of Arizona, Tucson, AZ, US, A. SIEVERS, editor Univ. of Bonn, Bonn, Germany, G. A. UBBELS, editor Netherlands Inst. for Devel. Biology, Utrecht, The Netherlands, T. W. HALSTEAD, editor NASA Headquarters, Washington, DC, US, M. D. ROSS, editor NASA Ames Research Center, Moffett Field, CA, US, S. J. ROUX, editor Univ. of Texas, Austin, TX, US, H. OSER, editor Microgravity Space Agency, Paris, France, B. F. LUJAN, editor NASA Headquarters, Washington, DC, US et al. *Advances in Space Research* (ISSN 0273-1177) vol. 14, no. 8 August 1994 462 p.

(For individual titles, see A95-60633 through A95-60691)

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The conference includes papers describing theories and models of cell biology in microgravity and weightlessness; experimental research on cellular responses to altered gravity in plants and animals, natural and simulated; graviresponses in plants; gravitational effects in developmental biology; mechanisms of gravisensing; effects on animals and humans; and educational programs in Space Life Sciences. Herner

A95-60633* National Aeronautics and Space Administration, Washington, DC.

PRODUCTION AND ACTION OF CYTOKINES IN SPACE

STEPHEN K. CHAPES Kansas State Univ., Manhattan, KS, US, DENNIS R. MORRISON NASA Johnson Space Center, Houston, TX, US, JAMES A. GUIKEMA Kansas State Univ., Manhattan, KS, US, MARIAN L. LEWIS Univ. of Alabama, Huntsville, AL, US, and BRIAN S. SPOONER Kansas State Univ., Manhattan, KS, US *Advances in Space Research* vol. 14, no. 8 August 1994 p. (8)5-(8)9 *Life sciences and space research* 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992.

(Contracts NAGW-1197; NAGW-2328; DAMD17-89-Z-9039)

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B6MP102 cells, a continuously cultured murine bone marrow macrophage cell line, were tested for secretion of tumor necrosis factor-alpha and Interleukin-1 during space flight. We found that B6MP102 cells secreted more tumor necrosis factor-alpha and interleukin-1 when stimulated in space with lipopolysaccharide than controls similarly stimulated on earth. This compared to increased secretion of interferon-beta and -gamma by lymphocytes that was measured on the same shuttle flights. Although space flight enhanced B6MP102 secretion of tumor necrosis factor-alpha, an experiment on a subsequent space flight (STS-50) found that cellular cytotoxicity, mediated by tumor necrosis factor-alpha, was inhibited. Author (Herner)

A95-60634

TRANSDUCTION OF THE GRAVITY STIMULUS IN THE ROOT STATOCYTE

G. PERBAL Pierre et Marie Curie Univ., Paris, France and D. DRISS-ECOLE Pierre et Marie Curie Univ., Paris, France *Advances in Space Research* (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)11-(8)19 *Life sciences and space research* 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992.

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The amyloplasts of root statocytes are considered to be the perceptrors of gravity. However, their displacement and the starch they contain are not required for gravisensing. The mechanism of the transduction of gravistimulus remains therefore controversial. It is well known that the amplitude of the stimulus is dependent upon the intensity of the acceleration and the inclination of the root with respect to gravity. This strongly supports the hypothesis that the stimulus results in a mechanical effect (pressure or tension) on a cellular structure. Three cellular components are proposed as possible candidates for the role of transducer: the actin filaments, the endoplasmic reticulum (ER) and the plasma membrane with its ion channels. Recent results obtained in the frame of the IML 1 Mission of Spacelab show that the endoplasmic reticulum should

rather be responsible for the termination of the stimulus. The contacts of amyloplasts with the distal ER could therefore be involved in the regulation of root growth. Author (Herner)

A95-60635

GRAVITATIONAL RESPONSE OF THE SLIME MOLD PHYSARUM

I. BLOCK DLR, Köln, Germany, A. WOLKE DLR, Köln, Germany, and W. BRIEGLEB DLR, Köln, Germany *Advances in Space Research* (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)21-(8)34 *Life sciences and space research* 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992.

(ISBN 0-08-042485-6) Copyright

The acellular slime mold *Physarum polycephalum* is used as a model system to investigate the graviresponse of single cells which possess no receptors specialized for the perception of gravity. To obtain insights into the gravity-signal transduction mechanism the light response of the cell is used: Macroplasmodia of the slime mold show clear geo- and phototaxes. Gravity increases and white light decreases transiently the contraction frequency of plasmodial strands whereby both responses follow the same time pattern. Since mitochondria play a major role in changing the contraction rhythm in response to light and gravity stimuli, the simultaneous and subsequent inductions of the opposing light and gravity responses and their mutual influences on one another were investigated. The experiments were performed in weightlessness (0 g) - simulated on the fast-rotating clinostat as well as in actual weightlessness during the IML-1 Space-Shuttle mission. The results indicate that mitochondria (chondriome) are part of the acceleration-stimulus reaction chain in *Physarum*. Two models for a direct gravireceptor mechanism are discussed. Author (Herner)

A95-60636

GRAVITY EFFECTS ON MEMBRANE PROCESSES

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Application of the Gouy-Chapman-Debye-Hueckel (GCDH) theory to a model membrane in contact with electrolytes of various concentrations and composition predict density variations within an interfacial layer. Assuming that on cellular dimensions hydrodynamics can be applied (the objections are briefly discussed) two types of gravity effects can be defined, (1) convection along the surface of vertically oriented membranes and (2) surface potential variations by layer deformations at horizontally oriented membranes. Both effects should affect transport across the layer to the membrane surface and across the membrane. According to the theoretical predictions first experiments with gramicidin channels incorporated into artificial phosphatidylserine bilayer membranes show a significant difference in single channel currents in vertical and horizontal membranes. The complexity of biological membrane functions requires investigation of isolated membrane surface reactions and transport systems to study the gravisensitivity for each process separately. Author (Herner)

A95-60637

PROTOZOA AS MODEL SYSTEMS FOR THE STUDY OF CELLULAR RESPONSES TO ALTERED GRAVITY CONDITIONS

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Germany, K. VOGEL Univ. of Erlangen, Erlangen, Germany, S. KLEIN Univ. of Koln, Koln, Germany, and M. MULISCH Univ. of Koln, Koln, Germany *Advances in Space Research* (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)49-(8)60 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. Research sponsored by the German Space Agency (DARA) (ISBN 0-08-042485-6) Copyright

The orientation behavior of *Paramecium* changed in a similar way after transition to conditions of free-fall in a sounding rocket and after transition to conditions of simulated weightlessness on a fast rotating clinostat. After a period of residual orientation, *Paramecium* cells distributed themselves randomly 80 s (120 s) after onset of free-fall (simulated weightlessness). Swimming velocity increased significantly; however, the increase was transient and subsided after 3 min in the rocket experiments, while the velocity remained enhanced even during 2 h of rotation on a fast clinostat. Trichocysts were present and without morphological changes in *Paramecium* cells which had been exposed to a rocket flight, as well as to fast or slow rotation on a clinostat. Regeneration of the oral apparatus of *Stentor* and morphogenesis of *Eufolliculina* proceeded normally on the clinostat. The results demonstrate that the clinostat is a useful tool to simulate the conditions of weightlessness on earth and to detect gravisensitive cellular functions. Author (Herner)

A95-60638* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

PITUITARY CELLS IN SPACE

W. C. HYMER Pennsylvania State Univ., Univ. Park, PA, US, K. SHELLENBERGER Pennsylvania State Univ., Univ. Park, PA, US, and R. GRINDELAND NASA. Ames Research Center, Moffett Field, CA, US *Advances in Space Research* (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)61-(8)70 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992.

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Cells of the mammalian pituitary gland synthesize and secrete several protein hormones which regulate a number of organ systems throughout the body. These include the musculoskeletal, immune, vascular and endocrine systems. Since changes occur in these tissues as a result of spaceflight, and since pituitary growth hormone (GH) and prolactin (PRL) play a role in the control of these systems on earth, we have focused attention over the last 10 years on GH and PRL cell function during and after spaceflight. The cumulative results of 4 spaceflight missions and several mimicked microgravity experiments establish 1) that production and release of biologically active GH and PRL is repeatedly and significantly attenuated (usually >50%) and 2) that changes in cell morphology also occur. In this paper we describe our results within the framework of methodologies and approaches frequently used to study pituitary cell function on earth. In so doing we hope to develop future flight experiments aimed at uncovering possible microgravity 'sensing systems' within the pituitary cell. Author (Herner)

A95-60639* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

SIMULATED MICROGRAVITY DOES NOT ALTER EPITHELIAL CELL ADHESION TO MATRIX AND OTHER MOLECULES

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(1). Gravitational biology; Interdisciplinary Scientific Comm. F of the COSPAR Plenary Meeting, 29th, Wash., DC, Aug. 28-Sep. 5, 1992. (Contracts CA42587; NAG9-520) (ISBN 0-08-042485-6) Copyright

Microgravity has advantages for the cultivation of tissues with high fidelity; however, tissue formation requires cellular recognition and adhesion. We tested the hypothesis that simulated microgravity does not affect cell adhesion. Human colorectal carcinoma cells were cultured in the NASA Rotating Wall Vessel (RWV) under low shear stress with randomization of the gravity vector that simulates microgravity. After 6 - 7 days, cells were assayed for binding to various substrates and compared to cells grown in standard tissue culture flasks and static suspension cultures. The RWV cultures bound as well to basement membrane proteins and to Carcinoembryonic Antigen (CEA), an intercellular adhesion molecule, as control cultures did. Thus, microgravity does not alter epithelial cell adhesion and may be useful for tissue engineering.

Author (Herner)

A95-60640

EFFECTS OF ALTERED GRAVITY ON PLANT CELL PROCESSES: RESULTS OF RECENT SPACE AND CLINOSTATIC EXPERIMENTS

E. L. KORDYUM Inst. of Botany, Kiev, Ukraine *Advances in Space Research* (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)77-(8)85 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992.

(ISBN 0-08-042485-6) Copyright

Space and clinostatic experiments revealed that plant cell structure and metabolism rearrangements depend on taxonomical position and physiological state of objects, growth phase and real or simulated microgravity influence duration. It was shown that clinostat conditions reproduce only a part of microgravity biological effects. It is established that various responses occur in microgravity: (1) rearrangements of cytoplasmic organelles ultrastructure and calcium balance; (2) physical-chemical properties of the plasmalemma are changed; (3) enzymes activity is often enhanced. These events provoke the acceleration of growth and differentiation of cells and their aging as a result; at the same time some responses can be considered as cell adaptation to microgravity. Author (Herner)

A95-60641

IN VITRO PLANT CELL GROWTH IN MICROGRAVITY AND ON CLINOSTAT

R. LAURINAVICIUS Inst. of Botany, Vilnius, Lithuania, P. KENSTAVICIENE Inst. of Botany, Vilnius, Lithuania, O. RUPAINIENE Inst. of Botany, Vilnius, Lithuania, and G. NECITAILO Inst. of Botany, Vilnius, Lithuania *Advances in Space Research* (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)87-(8)96 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992.

(ISBN 0-08-042485-6) Copyright

For the study of gravity's role in the processes of plant cell differentiation in-vitro, a model 'seed-seedling-callus' has been used. Experiments were carried out on board the orbital stations Salyut-7 and Mir as well as on clinostat. They lasted from 18 to 72 days. It was determined that the exclusion of a one-sided action of gravity vector by means of clinostat and spaceflight conditions does not impede the formation and growth of callus tissue; however, at cell and subcellular levels structural and functional changes do take place. No significant changes were observed either on clinostat or in space concerning the accumulation of fresh biomass, while the percentage of dry material in space is lower than in control. Both in microgravity (MG) and in control, even after 72 days of growth, cells with a normally developed ultrastructure are present. In space, however, callus tissue more often contains cells in which the cross-section area of a cells, a nuclei and of mitochondria are smaller and the vacuole area—bigger than in controls. In microgravity a consid-

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erable decrease in the number of starch-containing cells and a reduction in the mean area of starch grains in amyloplasts is observed. In space the amount of soluble proteins in callus tissue is 1.5 times greater than in control. However, no differences were observed in fractions when separated by the SDS-PAGE method. In microgravity the changes in cell wall material components was noted. In the space-formed callus changes in the concentration of ions K, Na, Mg, Ca and P were observed. However, the direction of these changes depends on the age of callus. Discussed are the possible reasons for modification of morphological and metabolic parameters of callus cells when grown under changed gravity conditions. Author (Herner)

A95-60642

CLINOSTATION INFLUENCE ON REGENERATION OF CELL WALL IN SOLANUM TUBEROSUM L. PROTOPLASTS

ELENA M. NEDUKHA Academy of Sciences, Kiev, Ukraine, V. A. SIDOROV Academy of Sciences, Kiev, Ukraine, and V. M. SAMOYLOV Academy of Sciences, Kiev, Ukraine Advances in Space Research (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)97-(8)101 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992.

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Regeneration of cell walls in protoplasts was investigated using light- and electronmicroscopic methods. The protoplasts were isolated from mesophyll of *Solanum tuberosum* leaves and were cultivated on the horizontal low rotating clinostat (2 rpm) and in control for 10 days. Using a fluorescent method (with Calcofluor white) it was demonstrated that changes in vector gravity results in an regeneration inhibition of cell wall. With electronmicroscopical and electro-cytochemical methods (staining with alcianum blue) dynamics of the regeneration of cell walls in protoplasts was studied; carbohydrate matrix of cell walls is deposited at the earliest stages of this process. The influence of microgravity on the cell wall regeneration is discussed in higher plants. Author (Herner)

A95-60643

LIPID PEROXIDATION OF PLANTS UNDER MICROGRAVITY AND ITS SIMULATION

S. I. ZHADKO Academy of Sciences, Kiev, Ukraine, YU. A. POLULYAKH Academy of Sciences, Kiev, Ukraine, T. V. VOROBYEVA Academy of Sciences, Kiev, Ukraine, and V. A. BARABOY Academy of Sciences, Kiev, Ukraine Advances in Space Research (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)103-(8)106 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992.

(ISBN 0-08-042485-6) Copyright

In series of space experiments a board the biosatellites 'Cosmos 1887', 'Bion 9', the orbital stations 'Salut', 'Mir' and under clinostating, changes of lipid peroxidation (LPO) and antioxidant activity (AOA) of *Chlorella*, *Haplopappus* tissue culture, wheat and pea roots were determined. The changes had a complex fluctuation character; three steps of response were established: LPO decreasing accompanied by AOA increase; stabilization LPO reversible reaction AOA balance; secondary LPO activation. Most early and highly amplitude decreasing of LPO were fixed in mitochondria. The rate of response have been increased on multicellular level of plants organization. Author (Herner)

A95-60644* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.

SOYBEAN COTYLEDON STARCH METABOLISM IS SENSITIVE TO ALTERED GRAVITY CONDITIONS

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1177) vol. 14, no. 8 August 1994 p. (8)107-(8)110 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. (ISBN 0-08-042485-6) Copyright

We have demonstrated that etiolated soybean seedlings grown under the altered gravity conditions of clinorotation (1 rpm) and centrifugation (5xg) exhibit changes in starch metabolism. Cotyledon starch concentration was lower (-28%) in clinorotated plants and higher (+24%) in centrifuged plants than in vertical control plants. The activity of ADP-glucose pyrophosphorylase in the cotyledons was affected in a similar way, i.e. lower (-37%) in the clinorotated plants and higher (+22%) in the centrifuged plants. Other starch metabolic enzyme activities, starch synthase, starch phosphorylase and total hydrolase were not affected by the altered gravity treatments. We conclude that the observed changes in starch concentrations were primarily due to gravity-mediated differences in ADP-glucose pyrophosphorylase activity. Author (Herner)

A95-60645* National Aeronautics and Space Administration, Washington, DC.

FORMATION AND VESICULATION OF BIOMEMBRANES DURING SPACEFLIGHT

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Shuttle flight, sounding rocket flight, and parabolic flight experiments demonstrate the formation of bilayer membrane vesicles (liposomes) in reduced gravity, following the dilution of detergent from detergent-phospholipid mixed micelles. The reduction in detergent concentration initiates assembly of bilayer membrane sheets, which are sensitive to solution disturbances. An increase in disturbances by forced dilution results in small diameter liposomes (less than 150 nm), in both ground and flight samples. In the absence of forced dilution, liposomes remain small at 1-g, but exhibit much larger diameters at 0-g (1000-2000 nm). Our spaceflight data reveal that membrane assembly and vesiculation are strongly influenced by gravity-induced solution disturbances (e.g., convection currents), which limit vesicle diameter. Author (Herner)

A95-60646

CELL BIOLOGY OF PLANT GRAVITY SENSING

F. D. SACK Ohio State Univ., Columbus, OH, US Advances in Space Research (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)117-(8)119 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992.

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The debate about whether gravity sensing relies upon statoliths (amyloplasts that sediment) has intensified with recent findings of gravitropism in starchless mutants and of claims of hydrostatic gravity sensing. Starch and significant plastid sedimentation are not necessary for reduced sensing in mutant roots, but plastids might function here if there were a specialized receptor for plastid mass e.g. in the endoplasmic reticulum (ER). Alternatively, components in addition to amyloplasts might provide mass for sensing. The nucleus is dense and its position is regulated, but no direct data exist for its role in sensing. If the weight of the protoplast functioned in sensing, why would there be specific cytological specializations favoring sedimentation rather than cell mass? Gravity has multiple effects on plants in addition to gravitropism. There may be more than one mechanism of gravity sensing. Author (Herner)

A95-60647

MECHANICAL ANALYSIS OF STATOLITH ACTION IN ROOTS AND RHIZOIDS

PAUL TODD Univ. of Colorado, Boulder, CO, US *Advances in Space Research* (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)121-(8)124 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Wash., DC, Aug. 28-Sep. 5, 1992. (ISBN 0-08-042485-6) Copyright

Published observations on the response times following gravistimulation (horizontal positioning) of Chara rhizoids and developing roots of vascular plants with normal and 'starchless' amyloplasts were reviewed and compared. Statolith motion was found to be consistent with gravitational sedimentation opposed by elastic deformation of an intracellular material. The time required for a statolith to sediment to equilibrium was calculated on the basis of its buoyant density and compared with observed sedimentation times. In the examples chosen, the response time following gravistimulation (from horizontal positioning to the return of downward growth) could be related to the statolith sedimentation time. Such a relationship implies that the transduction step is rapid in comparison with the perception step following gravistimulation of rhizoids and developing roots. Author (Herner)

A95-60648

CORRELATIONS BETWEEN CHANGES IN ELECTRICAL PARAMETERS AND CHANGES IN CELL ELONGATION RATES IN GRAVISTIMULATED ROOTS

H. ISHIKAWA Ohio State Univ., Columbus, OH, US and M. L. EVANS Ohio State Univ., Columbus, OH, US *Advances in Space Research* (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)125-(8)133 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. (ISBN 0-08-042485-6) Copyright

The earliest changes in growth rate following the gravistimulation of roots occur in a special group of cells between the meristem and the elongating region of the root. This zone is called the postmitotic isodiametric growth (PIG) zone and consists of cells which have ceased dividing and are expanding isodiametrically. Upon gravistimulation cells along the upper side of the PIG zone begin elongating rapidly and this accounts for much of the early growth asymmetry. There is rapid (less than 30 s) hyperpolarization of cells on the upper side of the PIG zone as well as rapid uptake of potassium from the stele. We propose that there is a relationship between the rate of hydrogen ion efflux and the extent of membrane hyperpolarization in the PIG zone and that such changes in potential are an early indication of impending changes in growth performance. Although the development of auxin asymmetry in the cap and its transmission to the elongating region is considered to be the controlling factor in root gravitropism, auxin asymmetry in the cap develops only after 30 min, about the same as the lag before initiation of curvature. Although this dilemma may be partly resolved by the location of the PIG zone close to the cap, alternative explanations such as gravi-detection by the PIG zone or very rapid (electrical?) signal transmission from the cap to the PIG zone need to be considered. Author (Herner)

A95-60649

DIFFERENTIAL FLANK GROWTH

H. E. ZIESCHANG Univ. Bonn, Bonn, Germany and A. SIEVERS Univ. Bonn, Bonn, Germany *Advances in Space Research* (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)135-(8)144 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. (ISBN 0-08-042485-6) Copyright

With the mathematical basis for the precise analysis of developmental processes in plants, the patterns of growth in phototropic and gravitropic responses have become better understood. A de-

tailed temporal and spatial quantification of a growth process is an important tool for evaluating hypotheses about the underlying physiological mechanisms. Studies of growth rates and curvature show that the original Cholodny-Went hypothesis cannot explain the complex growth patterns during tropic responses of shoots and roots. In addition, regulating factors other than the lateral redistribution of hormones must be taken into account. Electrophysiological studies on roots led to a modification of the Cholodny-Went hypothesis in that redistributions of bioelectrical activities are observed. Author (Herner)

A95-60650

BASIC ASSUMPTIONS AND COMPARISON OF THREE GRAVITROPIC RESPONSE MODELS

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Three systemic models of gravitropic response were compared by fitting different experimental data. Results indicate that fits improve with the inclusion of diageotropic component into formulas that allow to model plagiotropic orientation. More realistic simulation of gravitropic bending along an axial organ does not improve the fit but multiplies the number of parameters and causes correlation among them. However, such a model seems to have more possibilities for further improvement. Author (Herner)

A95-60651

OSCILLATIONS OF AXIAL PLANT ORGANS

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The tips of roots and shoots commonly show lateral movements as they grow forwards. These occur as both circumnutations (with long periods and large amplitudes) and micronutations (with short periods and small amplitudes). Their properties are reviewed, with emphasis on roots, and possible ways in which they could be regulated are discussed. The mechanisms could include long-range controls (for circumnutations) that depend on transmissible signals using steps common to gravitropism, and short-range controls (for micronutations) that operate within the elongation zone. The former are a property of the apex as a whole, while the latter may be confined to localized groups of cells. Simulation of nutations is presented with a view to isolating key physiological processes. However, this approach is limited by the current inadequate understanding of the growth mechanisms involved. Author (Herner)

A95-60652* National Aeronautics and Space Administration, Washington, DC.

PROGRESS IN PLANT RESEARCH IN SPACE

F. RONALD DUTCHER George Mason Univ., Washington, DC, US, ELIZABETH L. HESS George Mason Univ., Washington, DC, US, and THORA W. HALSTEAD NASA Headquarters, Washington, DC, US *Advances in Space Research* (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)159-(8)171 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. (ISBN 0-08-042485-6) Copyright

Progress is reviewed of spaceflight research conducted with plants between 1987 and 1992. Numerous plant experiments have been performed on spacecraft and sounding rockets in the past five years by scientists of the US, the former Soviet Union, Europe, and other areas. The experiments are categorized into three areas:

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gravity sensing, transduction, and response; development and reproduction; and metabolism, photosynthesis, and transport. The results of these experiments continue to demonstrate that gravity and/or other factors of spaceflight affect plants at the organismal, cellular, subcellular, and molecular levels, resulting in changes in orientation, development, metabolism, and growth. The challenge now is to truly dissect the effects of gravity from those of other spaceflight factors and to identify the basic mechanisms underlying gravity's effects. Author (Herner)

A95-60653* National Aeronautics and Space Administration, Washington, DC.

CLOVER DEVELOPMENT DURING SPACEFLIGHT: A MODEL SYSTEM

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The development of legume root nodules was studied as a model system for the examination of gravitational effects on plant root development. In order to examine whether rhizobial association with clover roots can be achieved in microgravity, experiments were performed aboard the KC-135 parabolic aircraft and aboard the sounding rocket mission Consort 3. Binding of rhizobia to roots and the initial stages of root nodule development successfully occurred in microgravity. Seedling germination experiments were performed in the sliding block device, the Materials Dispersion Apparatus, aboard STS-37. When significant hydration of the seeds was achieved, normal rates of germination and seedling development were observed. Author (Herner)

A95-60654

EXPERIMENTS ON EMBRYOS IN SPACE: AN OVERVIEW

R. BELLAIRS Univ. College, London, UK *Advances in Space Research* (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8) 179-(8)187 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. Research sponsored by The National Kidney Research Fund (ISBN 0-08-042485-6) Copyright

The question is, 'Does gravity play an essential role in the normal development of an embryo?'. Experiments on Earth which have disturbed the position of the embryo relative to the gravitational force, have implied that it does. But the critical tests are those in which the embryo is maintained in conditions of microgravity. The problems, both practical and conceptual, in conducting these experiments in Space, are considered, together with a brief discussion of selected achievements to date and a look at the problems to be tackled in the future. Author (Herner)

A95-60655

DEVELOPMENT OF PLANT PROTOPLASTS DURING THE IML-1 MISSION

O. RASMUSSEN Univ. of Aarhus, Aarhus, Denmark, **R. L. BONDAR** Canadian Space Agency, Canada, **C. BAGGERUD** Univ. of Trondheim, Norway, and **T. -H. IVERSEN** Univ. of Trondheim, Norway *Advances in Space Research* (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)189-(8)196 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. Research sponsored by the Danish Space Board and the Norwegian Research Council for Science and the Humanities (NAVF)

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During the 8 day IML-1 mission, regeneration of cell walls and cell divisions in rapeseed protoplasts were studied using the Biorack microscope onboard the Space Shuttle 'Discovery'. Samples from microgravity and 1g protoplast cultures were loaded on microscope slides. Visual microscopic observations were reported by the payload specialist Roberta Bondar, by down-link video transmission and by use of a microscope camera. Protoplasts grown under microgravity conditions do regenerate cell walls but to a lesser extent than under 1g. Cell divisions are delayed under microgravity. Few cell aggregates with maximum 4-6 cells per aggregate are formed under microgravity conditions, indicating that microgravity may have a profound influence on plant cell differentiation.

Author (Herner)

A95-60656

FERTILIZATION OF SEA URCHIN EGGS IN SPACE AND SUBSEQUENT DEVELOPMENT UNDER NORMAL CONDITIONS

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Sea urchin eggs are generally considered as most suitable animal models for studying fertilization processes and embryonic development. In the present study, they are used for determining a possible role of gravity in fertilization and the establishment of egg polarity and the embryonic axis. For this purpose, eggs of the particularly well known and suitable species *Paracentrotus lividus* have been automatically fertilized under microgravity conditions during the Swedish sounding rockets flights MASER IV and MASER V. It turns out, that fertilization 'in Space' occurs normally and that subsequent embryonic and larval development of such eggs, continued on the ground, is normal, leading to advanced pluteus stages. Author (Herner)

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DEVELOPMENT AND CHROMOSOME MECHANICS IN NEMATODES: RESULTS FROM IML-1

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A subset of the *Caenorhabditis elegans* nematodes flown aboard Biorack on IML-1 was analyzed for the fidelity of development and the mechanics of chromosomes at meiosis. To assess meiosis, mutant worms marked at two linked or unlinked loci were inoculated as heterozygous hermaphrodites and allowed to self fertilize. Mendelian segregation ratios and recombination frequency were measured for offspring produced at 1XG or in microgravity. To assess development, worms and embryos were fixed and stained with the DNA dye, Diamidinophenolindole (DAPI), or antibodies specific for antigens expressed in germ cells, pharyngeal and body wall muscles, and gut cells. The distribution of cytoplasmic determinants, cell nuclei counts and positions were scored to assess symmetry relations and anatomical features. Author (Herner)

A95-60658

ARTHROPOD MODEL SYSTEMS FOR STUDYING COMPLEX BIOLOGICAL PROCESSES IN THE SPACE ENVIRONMENT

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Three arthropod systems are discussed in relation to their complementary and potential use in Space Biology. In a next biosatellite flight, *Drosophila melanogaster* pre-adapted during several months to different g levels will be flown in an automatic device that separates parental from first and second generations. In the same flight, flies will be exposed to microgravity conditions in an automatic unit in which fly motility can be recorded. In the International Microgravity Laboratory-2, several groups of *Drosophila* embryos will be grown in Space and the motility of a male fly population will be video-recorded. In the Biopan, an ESA exobiology facility that can be flown attached to the exterior of a Russian biosatellite, *Artemia* dormant gastrulae will be exposed to the space environment in the exterior of the satellite under a normal atmosphere or in the void. Gastrulae will be separated in hit and non-hit populations. The developmental and aging response of these animals will be studied upon recovery. With these experiments we will be able to establish whether exposure to the space environment influences arthropod development and aging, and elaborate on some of the cellular mechanisms involved which should be tested in future experiments. Author (Herner)

A95-60659* National Aeronautics and Space Administration, Washington, DC.

EMBRYOGENESIS, HATCHING AND LARVAL DEVELOPMENT OF ARTEMIA DURING ORBITAL SPACEFLIGHT

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Developmental biology studies, using gastrula-arrested cysts of the brine shrimp *Artemia franciscana*, were conducted during two flights of the space shuttle Atlantis (missions STS-37 and STS-43) in 1991. Dehydrated cysts were activated, on orbit, by addition of salt water to the cysts, and then development was terminated by the addition of fixative. Development took place in 5 ml syringes, connected by tubing to activation syringes, containing salt water, and termination syringes, containing fixative. Comparison of space results with simultaneous ground control experiments showed that equivalent percentages of naupliar larvae hatched in the syringes (40%). Thus, reactivation of development, completion of embryogenesis, emergence and hatching took place, during spaceflight, without recognizable alteration in numbers of larvae produced. Post-hatching larval development was studied in experiments where development was terminated, by introduction of fixative, 2 days, 4 days, and 8 days after reinitiation of development. During spaceflight, successive larval instars or stages, interrupted by molts,

occurred, generating brine shrimp at appropriate larval instars. Naupliar larvae possessed the single naupliar eye, and development of the lateral pair of adult eyes also took place in space. Transmission electron microscopy revealed extensive differentiation, including skeletal muscle and gut endoderm, as well as the eye tissues. These studies demonstrate the potential value of *Artemia* for developmental biology studies during spaceflight, and show that extensive degrees of development can take place in this microgravity environment. Author (Herner)

A95-60660* National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, TX.

DEVELOPMENT STUDIES OF AURELIA (JELLYFISH)

EPHYRAE WHICH DEVELOPED DURING THE SLS-1 MISSION D. B. SPANGENBERG Eastern Virginia Medical School, Norfolk, VA, US, T. JERNIGAN NASA, Johnson Space Center, Houston, TX, US, R. MCCO MBS Eastern Virginia Medical School, Norfolk, CA, US, B. T. LOWE Eastern Virginia Medical School, Norfolk, VA, US, M. SAMPSON Eastern Virginia Medical School, Norfolk, VA, US, and J. SLUSSER Eastern Virginia Med. School, Norfolk, VA, US *Advances in Space Research* (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)239-(8)247 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Comm. F of the COSPAR Plenary Meet., 29th, Wash., DC, Aug. 28-Sep. 5, 1992. (Contracts NAG2-343; NAGW-1784) (ISBN 0-08-042485-6) Copyright

Aurelia polyps (scyphistomae) and ephyrae were exposed to microgravity for nine days aboard the space shuttle during the SLS-1 mission. During strobilation, polyps segment transversely and each segment develops into an ephyra. Polyps were induced to strobilate at 28 C, using iodine or thyroxine, at L(Launch)-48h, L-24h, and L+8h. Ephyrae developed in the groups tested in space and on Earth. The number of ephyrae formed per polyp was slightly higher in the L+8h groups as compared with those induced at L-24h and L-48h. On Earth, iodine is used by jellyfish to synthesize jellyfish-thyroxine (Jf T(sub 4)), needed for ephyra production. Since iodine-treated polyps strobilated and formed ephyrae in space, it appears that jellyfish can synthesize Jf-T(sub 4) in space. Indeed, two groups of polyps not given inducer formed ephyrae in space, presumably due to enhanced Jf-T(sub 4) synthesis, utilization or accumulation. Some ephyrae that formed in space were also fixed in space on Mission Day (MD) 8; others were fixed post-flight. Examination of living ephyrae with the light microscope and fixed ones with the Scanning and Transmission Electron Microscopes revealed that those which developed in space were morphologically very similar to those which developed on Earth. Quantitation of arm numbers determined that there were no significant differences between space and Earth-developed ephyrae. Pulsing abnormalities, however, were found in greater number (18.3%) in space-developed ephyrae than in Earth-developed controls (2.9%). These abnormalities suggest abnormal development of the graviceptors, the neuromuscular system, or a defect in the integration between these systems in apparently microgravity-sensitive animals. Author (Herner)

A95-60661* National Aeronautics and Space Administration, Washington, DC.

EARLY DEVELOPMENT OF XENOPUS EMBRYOS IS AFFECTED BY SIMULATED GRAVITY

HIROKI YOKOTA Indiana University, Bloomington, IN, US, ANTON W. NEFF Indiana University, Bloomington, IN, US, and GEORGE M. MALACINSKI Indiana University, Bloomington, IN, US *Advances in Space Research* (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)249-(8)255 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Comm. F of the COSPAR Plenary Meeting, 29th, Wash., DC, Aug. 28-Sep. 5, 1992. (Contract NAGW-1548) (ISBN 0-08-042485-6) Copyright

Early amphibian (*Xenopus laevis*) development under clinostat-simulated weightlessness and centrifuge-simulated hypergravity was studied. The results revealed significant effects on (i) 'morpho-

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logical patterning' such as the cleavage furrow pattern in the vegetal hemisphere at the eight-cell stage and the shape of the dorsal lip in early gastrulae and (ii) 'the timing of embryonic events' such as the third cleavage furrow completion and the dorsal lip appearance. Substantial variations in sensitivity to simulated force fields were observed, which should be considered in interpreting spaceflight data. Author (Hemer)

A95-60662

XENOPUS LAEVIS EMBRYOS CAN ESTABLISH THEIR SPATIAL BILATERAL SYMMETRICAL BODY PATTERN WITHOUT GRAVITY

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One assumes that gravity cooperates with the sperm in the establishment of bilateral symmetry in the embryo, particularly in species with yolky eggs. However, only experiments under genuine microgravity can prove this. May 2nd 1988 on the TEXUS-17 Sounding Rocket, eggs of *Xenopus laevis* became the first vertebrate eggs ever successfully fertilized in Space. Fertilization was done in fully automated hardware; the experiment was successfully repeated and extended in 1989. Here we report a 'Space First' from the IML-1 Space Shuttle mission (January 1992): In similar hardware and under microgravity, artificially fertilized *Xenopus* eggs started embryonic development. Histological fixation was pre-programmed at the time gastrulation would occur on Earth and indeed, gastrulae were fixed. Thus after fertilization in near weightlessness *Xenopus* embryos do develop bilaterally symmetrically, very probably cued by the sperm alone. Author (Hemer)

A95-60663

A DIRECT APPROACH TO THE STUDY OF THE EFFECT OF GRAVITY ON AXIS FORMATION IN BIRDS

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A system has been developed to enable the normal development of aborted very early uterine avian embryos, outside the female's uterus. The shell-less aborted egg was put into a foster shell of a sister egg, previously laid by the same female. The empty space between the shell and aborted egg was filled with artificial uterine fluid. The reconstructed eggs were incubated at 42 C for 30 hours in a vertical position. The atmosphere contained a high concentration of CO₂ (8-10%). At the termination of the 30 h the eggs were transferred to incubation at 37 C in normal atmospheric conditions. Normal development has been recorded for a certain percentage of eggs incubated up to 12 days. In other cases abnormalities, arrested development or development of extraembryonic membranes only, without a sign of an embryonic axis, have been observed. Author (Hemer)

A95-60664

TERATOGENIC EFFECTS OF GRAVITATIONAL CHANGES

P. J. DUKE Univ. of Texas, Houston, TX, US, D. MONTUFAR-SOLIS Univ. of Texas, Houston, TX, US, and E. DAANE Univ. of Texas, Houston, TX, US Advances in Space Research (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)281-(8)287 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. (ISBN 0-08-042485-6) Copyright

In investigating the effect of gravitational changes on development, it is instructive to think of altered gravity Δg as a teratogen - that is, an environmental factor influencing development. Observed effects on skeletal development include: suppression of morphogenesis in centrifuged mouse limb buds; advanced fusion stages in centrifuged mouse palates; smaller crown rump lengths (CRL) and decreased number of pregnancies in centrifuged rats and mice; altered differentiation of growth plates in young growing rats in space; and decreased length of calcified long bone regions in fetal rats exposed to microgravity in utero. These studies show that Δg is able to alter development in vivo and in vitro and suggest that Δg operates, at least in part, at the cellular level. Author (Hemer)

A95-60665

DEVELOPMENT OF TISSUE CULTURE TECHNIQUES AND HARDWARE TO STUDY MINERALIZATION UNDER MICROGRAVITY CONDITIONS

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To study the effects of weightlessness on mouse fetal long bone rudiment growth and mineralization we have developed a tissue culture system for the Biorack facility of Spacelab. The technique uses standard liquid tissue culture medium, supplemented with Na-beta-glycerophosphate, confined in gas permeable polyethylene bags mounted inside ESA Biorack Type 1 experiment containers. The containers can be flushed with an air/5% CO₂ gas mixture necessary for the physiological bicarbonate buffer used. Small amounts of fluid can be introduced at the beginning (e.g. radioactive labels for incorporation studies) or at the end of the experiment (fixatives). A certain form of mechanical stimulation (continuous compression) can be used to counteract the, possibly, adverse effect of micro-gravity. Using 16 day old metatarsals the in vitro calcification process under micro-gravity conditions can be studied for a 4 day period. Author (Hemer)

A95-60666

THE REACTION OF XENOPUS LAEVIS DAUDIN (SOUTH AFRICAN TOAD) TO LINEAR ACCELERATIONS

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Preparing the German Spacelab Mission D-2 project 'Gravity Perception and Neuronal Plasticity' - STATEX II - ground based experiments have been performed with larvae of the amphibian vertebrate *Xenopus laevis* Daud. to study the reactions to different levels of acceleration forces and profiles. The larvae have been

exposed to accelerations of up to 5 g for different time periods using a modified laboratory centrifuge and the NIZEMI (Niedergeschwindigkeits-Zentrifugen-Mikroskop) which allows direct observation and video documentation. The results will be discussed and compared with those of the D1-Mission, parabolic flights, and simulated weightlessness. Author (Herner)

A95-60667

IN VIVO FERTILIZATION AND DEVELOPMENT IN MICROGRAVITY USING PLEURODELE ('ZEUS' PROJECT)

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The objectives of this experiment are to perform natural fertilization and to achieve embryonic development in microgravity. *Pleurodeles waltl*, an urodele amphibian, is considered by Centre National d'Etudes Spatiales (CNES) and NASA to be suitable experimental material for achieving in vivo fertilization in space. Previously inseminated females can be embarked in the Frog Environmental Unit (FEU) developed by NASA. Laying of eggs will be provoked by hormonal stimulation in flight and development will be followed. Various technical problems have been resolved in laboratory experiments and during parabolic flights: the time of hormone stimulation after insemination, choice of hormone guaranteeing 95% success, other factors conditioning the laying, experimental procedures to study developmental kinetics at phenotypic levels, and selection of cellular and molecular markers of development. Author (Herner)

A95-60668

BEHAVIOURAL AND BIOCHEMICAL INVESTIGATIONS OF THE INFLUENCE OF ALTERED GRAVITY ON THE CNS OF AQUATIC VERTEBRATES DURING ONTOGENY

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Quantitative data are presented on the influences of hypergravity (3 plus or minus 1g) and of simulated weightlessness (approximately 0g) during early ontogeny of cichlid fish (*Oreochromis mossambicus*) and clawed toad (*Xenopus laevis*, Daudin) demonstrating changes in the swimming behavior and the brain energy and plasma membrane metabolism. After return to 1g conditions, hyperg reared fish and toads express the well known 'loop-swimming' behavior. By means of a computer based video analyzing system different types of swimming movements and velocities were quantitatively determined. Analyses of the brain energy and plasma-membrane metabolism of hyper-g fish larvae demonstrated an increase in energy availability (glucose 6Pi dehydrogenase, G-6P-DH), a decrease of cellular energy transformation (creatine kinase activity, CK) but no changes in energy consumptive processes (e.g. ATPases) and cytochrome oxidase activity (Cyt.-Ox). In contrast

hypo-g fish larvae showed a slight increase in brain CK activity. In addition, unlike 1g controls, hyper-g fish larvae showed pronounced variations in the composition (= polarity) of sialoglycosphingolipids (= gangliosides), typical constituents of the nerve cell membranes, and a slight increase in the activity of sialidase, the enzyme responsible for ganglioside degradation. Author (Herner)

A95-60669* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

GRAVICEPTOR DEVELOPMENT IN JELLYFISH EPHYRAE IN SPACE AND ON EARTH

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Graviceptor (rhopalium) development in *Aurelia aurita* ephyrae which developed on Earth and in space during the nine-day NASA SLS-1 mission was compared. The space-developed ephyrae made graviceptors which were morphologically similar to those of their ground-based controls. Rhopalia of both groups developed statocysts with statoliths, ocelli, ciliated mechanoreceptor cells, and immature touch-plates with one type of hair cell. The number of rhopalia formed per arm of ephyrae of both groups revealed no significant differences. The number of statoliths formed per rhopalium was statistically higher in ephyrae which were induced to form in space with iodine than in L(Launch)+8h controls. Statolith numbers were not significantly different between Earth-formed control ephyrae and those formed from polyps induced on Earth and then sent into space 24h and 48h later. Statolith loss from rhopalia was significantly enhanced in the space-maintained ephyrae in artificial sea water (ASW) as compared to their controls. Ephyrae formed through thyroxine treatment and those maintained in thyroxine in space had statolith numbers comparable to thyroxine-treated controls. Pulsing abnormalities seen in some space-developed ephyrae suggest that some space-formed ephyrae may have developed abnormal rhopalia because normal rhopalia development and function is necessary for normal pulsing. Author (Herner)

A95-60670* National Aeronautics and Space Administration, Washington, DC.

FORMATION OF OTOCONIA IN THE JAPANESE RED-BELLIED NEWT, CYNOPS PYRRHOGASTER

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Pre-mated adult female newts and fertilized eggs will be flown on the International Microgravity Laboratory-2 flight, in 1994. One objective of the flight will be to observe the influence of microgravity on the development of the gravity-sensing organs in the inner ear. These organs contain sensory hair cells covered by a layer of dense stones (otoconia). Gravity and linear acceleration exert forces on these masses, leading to excitation of the nerve fibers innervating the hair cells. If the production of the otoliths is regulated to reach an optimal weight, their development might be abnormal in microgravity. Ground-based control experiments are reported describing the developmental sequence in which both the otoliths and their asso-

ciated sensory epithelium and the semicircular canals appear and develop. Three-dimensional reconstruction of serial sections through the otic vesicle of newt embryos at stages 31 through 58 demonstrate the first appearance, relative position and growth of the otoliths. Reports of experiments in which fertilized frog eggs were flown on a Russian Cosmos mission conclude that the utricular otolith is increased in volume, whereas the saccular otolith maintains normal size, suggesting that at least in the utricle, the weight of the otolith might be regulated. Author (Herner)

A95-60671

PHYSIOLOGICAL, BIOCHEMICAL AND MOLECULAR PROCESSES ASSOCIATED WITH GRAVITROPISM IN ROOTS OF MAIZE

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This research aims to characterize regulation of the principal cytosolic protein kinases in maize, cultivar 'Merit' root tips, since much evidence indicates that stimuli which modulate the gravitropic response in this system act through regulation of activity of these enzymes. To this end, we have cloned a maize protein kinase belonging to a group of plant protein kinases with a catalytic domain similar in primary structure to the second messenger-regulated protein kinases known in animal and fungal systems. However, both the unique structural features conserved among plant protein kinases in this group, and lack of evidence for cyclic nucleotide signalling in plants point to operation of a novel protein kinase regulatory mechanism in plants. In order to test effects of possible regulators on protein kinase activity, we developed a sensitive method for detecting regulation of autophosphorylation of protein kinases in unfractionated maize protein extracts. Regulation of protein kinase autophosphorylation in these extracts was different from that known in animals and fungi, further suggesting operation of unique protein kinase regulatory mechanisms in plants. Previous research has shown that light, or factors modulated by light, regulate plant protein kinase activity. We found that protein kinase activity was co-immunoprecipitated with the plant photoreceptor phytochrome, and was associated with phytochrome by high-affinity chemical interactions. Far-red reversibility of red-light regulation of phytochrome phosphorylation by the associated protein kinase indicates that it may modulate or transduce the light signals which lead to gravitropic sensitivity in 'Merit' maize. Author (Herner)

A95-60672* National Aeronautics and Space Administration, Washington, DC.

IMMUNOLocalIZATION OF AN ANNEXIN-LIKE PROTEIN IN CORN

G. B. CLARK Univ. of Texas, Austin, TX, US, M. DAUWALDER Univ. of Texas, Austin, TX, US, and S. J. ROUX Univ. of Texas, Austin, TX, US *Advances in Space Research* (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)341-(8)346 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992.

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Although calcium has been proposed to be an important regulatory element in plant gravitropic growth, as yet no specific function of Ca^{2+} in growth regulation has been discovered. Our recent studies on a Ca^{2+} -binding protein in pea seedlings called p35 indicate that it is a member of the annexin family of proteins and may play a key role in growth regulation through its function in delivering polysaccharides needed for wall construction. We previously reported the isolation of p35 from pea plumules and the production of polyclonal antibodies to it. Immunolocalization analy-

ses of p35 in pea tissues revealed high levels of staining in secretory cell types such as developing vascular cells and outer root cap cells. To test how general was the occurrence and distribution of this annexin-like protein in plant cells we initiated an analysis of annexins in the monocot corn using immunological techniques. Our results indicate the immunochemical properties and localization of corn annexins are very similar to those reported for pea. They are consistent with the postulate that annexins may play a general role in the regulation of the secretion of wall polysaccharides needed for growth, and thus could be an important target of calcium action during gravitropic growth. Author (Herner)

A95-60673

CENTRAL HEMODYNAMICS IN A BABOON MODEL DURING MICROGRAVITY INDUCED BY PARABOLIC FLIGHT

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We developed a chronically instrumented nonhuman primate model (baboon) to evaluate the central cardiovascular responses to transient microgravity induced by parabolic flight. Instrumentation provided simultaneous recording of high fidelity (Ao) and pulmonary artery (PA) pressures, right and left ventricular and atrial pressures, Ao and PA blood flow velocities and vessel dimensions, electrocardiogram (ECG) and pleural pressures. Four daily flights in 1991 and five in 1992 were flown with forty parabolas per flight. Animals flown in 1991 were not controlled for volume status. Animals flown in 1992 were studied in one of three conditions: (1) volume depleted by furosemide (DH), (2) volume expanded by saline infusion (VE), and (3) euvoletic (EU, no intervention, used for echo only). Mean right atrial pressures (RAP) during 1991 flights had a variable early microgravity response: increases in $n = 3$ and decrease in $n = 3$ (supine) and increases in $n = 5$, decreases in $n = 2$ (upright). In 1992 flights, DH, upright and supine, changed -10 plus or minus 4.1 mmHg, -3.2 plus or minus 2.2 mmHg, respectively (p less than .05) compared to the pull-up phase. In contrast, VE changed (from pull-up to microgravity) +13 plus or minus 1.5 mmHg and +4.25 plus or minus 2.9 mmHg (upright and supine, respectively, p less than .05). EU increased with microgravity +6.9 plus or minus .9 mmHg (upright only). Mean left atrial pressures (LAP) responses were similar, but more variable. Finally, heart chamber areas paralleled pressure changes. Thus, right and left heart filling pressure changes with sudden entry into microgravity conditions were dependent on initial circulatory volume status and somewhat modified by position (supine vs upright). Author (Herner)

A95-60675

COMPARISON OF THE EFFECTS OF SPACEFLIGHT AND HINDLIMB-SUSPENSION ON RAT PITUITARY VASOPRESSIN AND BRAINSTEM NOREPINEPHRINE CONTENT

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To compare actual spaceflight to ground-based simulation (hindlimb-suspension), we measured the norepinephrine (NE) content in A1, A2, A5 and A6 (locus coeruleus) and the vasopressin content in the neurohypophyseal system. The experimental period was of 9 days' duration. The NE content in the locus coeruleus decreased significantly in rats flown for 9 days (67%, p less than 0.001), but showed no significant changes after hindlimb-suspension. These results demonstrated that suspended rats adapted better to weightlessness-simulation than flown rats to actual microgravity. In rats flown aboard SLS-1, the vasopressin content was significantly increased in the posterior pituitary (71%, p less than 0.01), and was decreased in the hypothalamus (49%, p less than 0.05). In 9-day suspended rats pituitary vasopressin levels were unchanged, while in the hypothalamus a significant decrease was noted (21%, p less than 0.05). It was concluded that spaceflight changes in pituitary vasopressin levels and in the locus coeruleus NE content were consistent with a stress reaction, occurring during and/or after landing. These results confirmed that hindlimb-suspension model constitutes a valid and less stressful ground-based simulation of microgravity in rats. Author (Herner)

A95-60677

CHANGES OF CONTRACTILE RESPONSES DUE TO SIMULATED WEIGHTLESSNESS IN RAT SOLEUS MUSCLE

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Some contractile and electrophysiological properties of muscle fibers isolated from the slow-twitch soleus (SOL) and fast-twitch extensor digitorum longus (EDL) muscles of rats were compared with those measured in SOL muscles from suspended rats. In suspended SOL (21 days of tail-suspension) membrane potential (E_m), intracellular sodium activity (a_{Na}) and the slope of the relationship between E_m and $\log K(\text{sub } o)$ were typical of fast-twitch muscles. The relation between the maximal amplitude of K-contractions vs E_m was steeper for control SOL than for EDL and suspended SOL muscles. After suspension, in SOL muscles the contractile threshold and the inactivation curves for K-contractions were shifted to more positive E_m . Repriming of K-contractions was unaffected by suspension. The exposure of isolated fibers to perchlorate $\text{ClO}_4(-)$ -containing (6-40 mM) solutions resulted in a similar concentration-dependent shift to more negative E_m of activation curves for EDL and suspended SOL muscles. On exposure to a Na-free TEA solution, SOL from control and suspended rats, in contrast to EDL muscles, generated slow contractile responses. Suspended SOL showed a reduced sensitivity to the contracture-producing effect of caffeine compared to control muscles. These results suggested that the modifications observed due to suspension could be encountered by changes in the characteristics of muscle fibers from slow to fast-twitch type. Author (Herner)

A95-60679

CHANGES OF ENDOLYMPHATIC PRESSURE IN THE SEMICIRCULAR CANAL OF PIGEON BY CALORIE STIMULATION

Y. WADA Nagoya Univ., Nagoya, Japan, H. SUZUKI Nagoya Univ., Nagoya, Japan, and S. WATANABE Nagoya Univ., Nagoya, Japan Advances in Space Research (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)385-(8)388 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. (ISBN 0-08-042485-6) Copyright

It gets difficult to explain the mechanism of caloric nystagmus only by convection theory from results of microgravity experiments.

One of the other theories is an occurrence of a relative volume change due to a temperature change. Since the volume change must lead to a pressure change after caloric stimulation, we tried to measure the ampulla pressure of the horizontal semicircular canal in pigeons (*Columba livia*) using an improved servo micropipette system. The main result was that the ampulla pressure increased by cooling and decreased by heating. The changes of the ampulla pressure depended on the temperature change but were not influenced by the pigeon's head position. Author (Herner)

A95-60682* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

INFLUENCE OF GRAVITY ON THE CIRCADIAN TIMING SYSTEM

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The circadian timing system (CTS) is responsible for daily temporal coordination of physiological and behavioral functions both internally and with the external environment. Experiments in altered gravitational environments have revealed changes in circadian rhythms of species ranging from fungi to primates. The altered gravitational environments examined included both the microgravity environment of spaceflight and hyperdynamic environments produced by centrifugation. Acute exposure to altered gravitational environments changed homeostatic parameters such as body temperature. These changes were time of day dependent. Exposure to gravitational alterations of relatively short duration produced changes in both the homeostatic level and the amplitude of circadian rhythms. Chronic exposure to a non-earth level of gravity resulted in changes in the period of the expressed rhythms as well as in the phase relationships between the rhythms and between the rhythms and the external environment. In addition, alterations in gravity appeared to act as a time cue for the CTS. Altered gravity also affected the sensitivity of the pacemaker to other aspects of the environment (i.e., light) and to shifts of time cues. Taken together, these studies lead to the conclusion that the CTS is indeed sensitive to gravity and its alterations. This finding has implications for both basic biology and space medicine. Author (Herner)

A95-60685

BEHAVIOR OF JAPANESE TREE FROGS UNDER MICROGRAVITY ON MIR AND IN PARABOLIC FLIGHT

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Japanese tree frogs (*Hyla japonica*) were flown to the space station MIR and spent eight days in orbit during December, 1990. Under microgravity, their postures and behaviors were observed and recorded. On the MIR, floating frogs stretched four legs out, bent their bodies backward and expanded their abdomens. Frogs on a

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surface often bent their neck backward and walked backwards. This behavior was observed on parabolic flights and resembles the retching behavior of sick frogs on land—a possible indicator of motion sickness. Observations on MIR were carried out twice to investigate the frog's adaptation to space. The frequency of failure in landing after a jump decreased in the second observation period. After the frogs returned to earth, readaptation processes were observed. The frogs behaved normally as early as 2.5 hours after landing.

Author (Herner)

A95-60687* National Aeronautics and Space Administration, Washington, DC.

EDUCATIONAL OPPORTUNITIES WITHIN THE NASA SPECIALIZED CENTER OF RESEARCH AND TRAINING IN GRAVITATIONAL BIOLOGY

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The NASA Specialized Center of Research and Training (NSCORT) in Gravitational Biology was established at Kansas State University, supported through NASA's Life Science Division, Office of Space Science and Applications. Educational opportunities, associated with each of the research projects which form the nucleus of the Center, are complemented by program enrichments such as scholar exchanges and linkages to other NASA and commercial programs. The focus of this training program, and a preliminary assessment of its successes, are described.

Author (Herner)

A95-60688

FOUR EDUCATIONAL PROGRAMS IN SPACE LIFE SCIENCES

M. W. LUTTGES University of Colorado, Boulder, CO, US, L. S. STODIECK University of Colorado, Boulder, CO, US, and D. M. KLAUS University of Colorado, Boulder, CO, US *Advances in Space Research* (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)439-(8)446 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992.

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Four different educational programs impacting Space Life Sciences are described: the NASA/USRA Advanced Design Program, the NASA Specialized Center of Research and Training (NSCORT) Program, the Centers for the Commercial Development of Space (CCDS) Program, and the NASA Graduate Research Fellow Program. Each program makes somewhat different demands on the students engaged in them. Each program, at the University of Colorado, involves Space Life Sciences training. While the Graduate Student Research Fellow and NSCORT programs are discipline oriented, the Advanced Design and CCDS Programs are focused on design, technologies and applications. Clearly, the 'training paradigms' differ for these educational endeavors. But, these paradigms can be made to mutually facilitate enthusiasm and motivation. *Discipline-oriented academic programs, ideally, must be flexible enough to accommodate the emergent cross-disciplinary needs of Space Life Sciences students. Models for such flexibility and resultant student performance levels are discussed based upon actual academic and professional records.*

Author (Herner)

A95-60689* National Aeronautics and Space Administration, Washington, DC.

NASA'S SPACE LIFE SCIENCES TRAINING PROGRAM

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US, and D. ATCHISON Lockheed Engineering and Sciences Company, Washington, DC, US *Advances in Space Research* (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)447-(8)449 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992.
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The Space Life Sciences Training Program (SLSTP) is an intensive, six-week training program held every summer since 1985 at the Kennedy Space Center (KSC). A major goal of the SLSTP is to develop a cadre of qualified scientists and engineers to support future space life sciences and engineering challenges. Hand-picked, undergraduate college students participate in lectures, laboratory sessions, facility tours, and special projects: including work on actual Space Shuttle flight experiments and baseline data collection. At NASA Headquarters (HQ), the SLSTP is jointly sponsored by the Life Sciences Division and the Office of Equal Opportunity Programs: it has been very successful in attracting minority students and women to the fields of space science and engineering. In honor of the International Space Year (ISY), 17 international students participated in this summer's program. An SLSTP Symposium was held in Washington D. C., just prior to the World Space Congress. The Symposium attracted over 150 SLSTP graduates for a day of scientific discussions and briefings concerning educational and employment opportunities within NASA and the aerospace community. Future plans for the SLSTP include expansion to the Johnson Space Center in 1995.

Author (Herner)

A95-60690* National Aeronautics and Space Administration, Washington, DC.

LIFE IN THE UNIVERSE: FOUNDATION FOR EXCITING MULTIDISCIPLINARY SCIENCE ACTIVITIES FOR MIDDLE AND ELEMENTARY SCHOOL CLASSES

D. MILNE SETI Institute, Mountain View, CA, US and K. O'SULLIVAN San Francisco State University, San Francisco, CA, US *Advances in Space Research* (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)451-(8)458 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. Research sponsored by the National Science Foundation and NASA
(ISBN 0-08-042485-6) Copyright

Young students find extra-terrestrial life one of the most intriguing of all topics. A project funded by the National Science Foundation and NASA, and administered by the SETI Institute, is underway to devise science lessons for grades 3-9 that draw upon this fascination. The lessons are designed by teachers and persons with long experience at curriculum design, tested in classrooms, revised and retested. Six guides, each containing some 6-10 science lessons, will be finished by summer, 1994. The theme *Life in the Universe* lends itself naturally to integrated treatment of facts and concepts from many scientific disciplines. The lessons for two completed guides span the origin of planet systems, evolution of complex life, chemical makeup of life, astronomy, spectroscopy, continental drift, mathematics and SETI (Search for Extra-Terrestrial Intelligence). All lessons are hands-on, interesting, and successful.

Author (Herner)

A95-60691

EDUCATIONAL PROJECTS IN SPACE LIFE SCIENCES IN CANADA

ALAN J. MORTIMER Canadian Space Agency, Ottawa, Ontario, Canada *Advances in Space Research* (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)459-(8)460 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992.

(ISBN 0-08-042485-6) Copyright

As part of its mandate the Space Life Sciences Program within the Canadian Space Agency has worked to increase interest in space and develop young scientists. Projects have been undertaken

at the public school and high school level, with classroom resource material and science contests; at the university level with summer training programs, and at the post-graduate level with opportunities to complete research projects in a microgravity environment.

Author (Hemer)

N95-10337* Texas Univ., San Antonio, TX. Dept. of Life Sciences.

MONOCLONAL ANTIBODIES DIRECTED AGAINST SURFACE MOLECULES OF MULTICELL SPHEROIDS

Semiannual Status Report, 1 Jan. - 1 Jun. 1994

ANDREW O. MARTINEZ 1994 46 p

(Contract NAG2-819)

(NASA-CR-196385; NAS 1.26:196385) Avail: CASI HC A03/MF A01

The objective of this project is to generate a library of monoclonal antibodies (MAbs) directed against surface molecules of tumor and transformed cells grown as multicell spheroids (MCS). These MCS are highly organized, 3-dimensional multicellular structures which exhibit many characteristics of in vivo organized tissues not found in conventional monolayer or suspension culture. Therefore MCS make better in vitro model systems to study the interactions of mammalian cells, and provide a functional assay for surface adhesion molecules. This project also involves investigations of cell-cell interactions in a gravity-based environment. It will provide a base of scientific information necessary to expand the focus of the project in future years to microgravity and hypergravity-based environments. This project also has the potential to yield important materials (e.g., cellular products) which may prove useful in the diagnosis and/or treatment of certain human diseases. Moreover, this project supports the training of both undergraduate and graduate students; thus, it will assist in developing a pool of future scientists with research experience in an area (gravitational biology) of interest to NASA.

Author

N95-10826* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

THE CONTROLLED ECOLOGICAL LIFE SUPPORT SYSTEM ANTARCTIC ANALOG PROJECT: ANALYSIS OF WASTEWATER FROM THE SOUTH POLE STATION, ANTARCTICA, VOLUME 1

MICHAEL T. FLYNN, DAVID L. BUBENHEIM, CHRISTIAN L. STRAIGHT, and WARREN BELISLE Aug. 1994 23 p

(NASA-TM-108836; A-94109; NAS 1.15:108836) Avail: CASI HC A03/MF A01

The Controlled Ecological Life Support system (CELSS) Antarctic Analog Project (CAAP) is a joint National Science Foundation (NSF) and NASA project for the development, deployment and operation of CELSS technologies at the Amundsen-Scott South Pole Station. NASA goals are operational testing of CELSS technologies and the conduct of scientific studies to facilitate technology selection and system design. The NSF goals are that the food production, water purification, and waste treatment capabilities which will be provided by CAAP will improve the quality of life for the South Pole inhabitants, reduce logistics dependence, and minimize environmental impacts associated with human presence on the polar plateau. This report presents an analysis of wastewater samples taken from the Amundsen-Scott South Pole Station, Antarctica. The purpose of the work is to develop a quantitative understanding of the characteristics of domestic sewage streams at the South Pole Station. This information will contribute to the design of a proposed plant growth/waste treatment system which is part of the CELSS Antarctic Analog Project (CAAP).

Author

N95-10828* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

A METABOLIC CAGE FOR THE HINDLIMB SUSPENDED RAT

J. EVANS, G. M. MULENBURG, J. S. HARPER, T. L. SKUNDBERG, M. NAVIDI, and S. B. ARNAUD Jul. 1994 39 p

(Contract RTOP 199-26-12-02)

(NASA-TM-108830; A-94094; NAS 1.15:108830) Avail: CASI HC A03/MF A01

Hindlimb suspension has been successfully used to simulate the effects of microgravity in rats. The cage and suspension system developed by E. R. Holton is designed to produce a headward shift of fluid and unload the hindlimbs in rodents, causing changes in bone and muscle similar to those in animals and humans exposed to spaceflight. While the Holton suspension system simulates many of the conditions observed in the spaceflight animal, it does not provide for the collection of urine and feces needed to monitor some metabolic activities. As a result, only limited information has been gathered on the nutritional status, and the gastrointestinal and renal function of animals using that model. Although commercial metabolic cages are available, they are usually cylindrical and require a centrally located suspension system and thus, do not readily permit movement of the rats. The limited floor space of commercial cages may affect comparisons with studies using the Holton model which has more than twice the living space of most commercially available cages. To take advantage of the extra living space and extensive data base that has been developed with the Holton model, Holton's cage was modified to make urine and fecal collections possible.

Author

N95-10863* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

BIOTELEMETRY IMPLANT VOLUME AND WEIGHT IN RATS: A PILOT STUDY REPORT

CHRIS J. SOMPS May 1994 19 p

(Contract RTOP 545-20-01)

(NASA-TM-108812; A-94059; NAS 1.15:108812) Avail: CASI HC A03/MF A01

This paper reports the results of a pilot study in which a 240-gram rat was implanted for 41 days with biotelemetry devices weighing a total of 36 gm (18 cc). The implanted animal showed no differences in weight gain, food and water consumption, and postnecropsy organ weights when compared to both an unoperated control animal and an animal that underwent surgery but did not receive an implant. The implanted animal also had temperature and activity rhythms similar to those reported using much smaller implants. Thus, this pilot study showed that a 240-gm rat could be implanted with biotelemetry devices weighing nearly 15 percent of body weight without significant changes in health or behavior. A larger study involving more animals and similar implant sizes is recommended.

Author

N95-10920 Krug Life Sciences, Inc., San Antonio, TX.

EFFECT OF RATE OF HEAT GAIN ON SELECTED SERUM ENZYMES IN RHESUS MONKEYS Interim Report, Feb.

1992 - May 1993

CRISTINE L. HEAPS and STEFAN H. CONSTABLE Apr. 1994 12 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality

(Contract F33615-89-C-0603)

(AD-A280861; AL/CF-TR-1993-0121) Avail: CASI HC A03

Cell membrane leakage of sodium and potassium ions results in an energy drain at the cellular level as active transport activity must increase to maintain the membrane potential. This membrane permeability increases as body temperature rises, a result of an increase in the kinetic energy of the ions. Thermal stress and the resultant increased cell membrane permeability poses a challenge to the cell to maintain homeostasis and may contribute to fatigue during physical exertion. Ultimately, the work capacity of an individual may be limited by this cellular energy drain. Hubbard suggests that the rate of heat gain plays a significant role in the energy drain at the cellular level as membrane permeability increases dramatically with faster rates of heat storage. This relationship is described as part of the Energy Depletion Model developed by Hubbard et al.

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(4) and has been examined in the rat model by both Hubbard et al. and Manjoo et al. DTIC

N95-11218* Florida Univ., Gainesville, FL. Dept. of Horticultural Sciences.

INTEGRATED DEVELOPMENTAL MODEL OF LIFE-SUPPORT CAPABILITIES IN WHEAT Final Report

R. L. DARNELL and C. O. OBRIEN 25 Aug. 1994 9 p
(Contract NAG10-133)
(NASA-CR-196428; NAS 1.26:196428) Avail: CASI HC A02/MF A01

The objective of this project was to develop a model for CO₂, O₂, H₂O, and nitrogen use during the life cycle of wheat. Spreadsheets and accompanying graphs were developed to illustrate plant population reactions to environmental parameters established in the Controlled Ecological Life Support System (CELSS) program at Kennedy Space Center, FL. The spreadsheets and graphs were produced using validated biomass production chamber (BPC) data from BWT931. Conditions of the BPC during the 83 day plant growth period were as follows: The BPC area is 27.8 m² (exp 2), volume is 113 m³ (exp 3). Temperatures during the 83 day plant growth period ranged from 16.3 to 24.8 C during the light cycle (except for day 69, when the minimum and maximum temperatures were 7.7 C and 7.9 C, respectively) and 14.5 C and 23.6 C during the dark cycle (except for day 49, when the minimum and maximum temperatures were 11.1 C and 11.3 C, respectively). Relative humidity was 85 percent for the first seven days of plant growth, and 70 percent thereafter. The plant leaf canopy area was 10 m² (exp 2). Presented is a list and explanation of each spreadsheet and accompanying graph(s), conditions under which the data were collected, and formulas used to obtain each result.

Derived from text

N95-11697* Argonne National Lab., IL. ANAEROBIC METABOLISM OF NITROAROMATIC COMPOUNDS BY SULFATE-REDUCING AND METHANOGENIC BACTERIA

R. BOOPATHY and C. F. KULPA 1994 47 p Presented at the Symposium on the Biodegradation of Nitroaromatic Compounds, Las Vegas, NV, 22-23 May 1994
(Contract W-31-109-ENG-38)
(DE94-013317; ANL/ER/CP-82983; CONF-9405165-1) Avail: CASI HC A03/MF A01

Ecological observations suggest that sulfate-reducing and methanogenic bacteria might metabolize nitroaromatic compounds under anaerobic conditions if appropriate electron donors and electron acceptors are present in the environment, but this ability had not been demonstrated until recently. Most studies on the microbial metabolism of nitroaromatic compounds used aerobic microorganisms. In most cases, no mineralization of nitroaromatics occurs, and only superficial modifications of the structures are reported. However, under anaerobic sulfate-reducing conditions, the nitroaromatic compounds reportedly undergo a series of reductions with the formation of amino compounds. For example, trinitrotoluene under sulfate-reducing conditions is reduced to triaminotoluene by the enzyme nitrite reductase, which is commonly found in many *Desulfovibrio* spp. The removal of ammonia from triaminotoluene is achieved by reductive deamination catalyzed by the enzyme reductive deaminase, with the production of ammonia and toluene. Some sulfate reducers can metabolize toluene to CO₂. Similar metabolic processes could be applied to other nitroaromatic compounds like nitrobenzene, nitrobenzoic acids, nitrophenols, and aniline. Many methanogenic bacteria can reduce nitroaromatic compounds to amino compounds. In this paper, we review the anaerobic metabolic processes of nitroaromatic compounds under sulfate-reducing and methanogenic conditions. DOE

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AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

A95-60674

APPLIED POTENTIAL TOMOGRAPHY SHOWS DIFFERENTIAL CHANGES IN FLUID CONTENT OF LEG TISSUE LAYERS IN MICROGRAVITY

F. J. BAISCH DLR, Koln, Germany Advances in Space Research (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)359-(8)364 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. (ISBN 0-08-042485-6) Copyright

Absence of hydrostatic forces in the human cardiocirculatory system normally leads to an overall body fluid deficit. It was hypothesized that this is mainly due to a loss of interstitial fluid. An experiment was performed on board the Russian MIR station. Cuffs were positioned around both thighs and inflated up to suprasystolic values. This maneuver took place just before and after immediately a lower body negative pressure session (LBNP). The redistribution of fluids underneath the cuffs was assessed by means of cross-sectional impedance tomography (Applied Potential Tomography, APT). A microgravity induced loss of interstitial fluid was measured in all layers of the observed cross-section. The APT-readings changed significantly (SD approximately +/- .9) from 3.0 at 1g to 1.7 at 0g for the outer layer and from 2.7 at 1g to 2.0 at 0g for the middle layer (expressed in arbitrary units). The LBNP maneuver was able to fill the interstitial space but only at levels higher than -15 mmHg LBNP. This suggests that the superficial tissues in the legs are as much affected as the deeper ones by changing g-conditions and LBNP can be used to counteract interstitial fluid loss in this area.

Author (Herner)

A95-60676

TERRESTRIAL APPLICATIONS OF BONE AND MUSCLE RESEARCH IN MICROGRAVITY

F. W. BOOTH Univ. of Texas, Houston, TX, US Advances in Space Research (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8) 373-(8)376 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Comm. F of the COSPAR Plenary Meeting, 29th, Wash., DC, Aug. 28-Sep. 5, 1992. (ISBN 0-08-042485-6) Copyright

Major applications to people on Earth are possible from NASA-sponsored research on bone and muscle which is conducted either in microgravity or on Earth using models mimicking microgravity. In microgravity bone and muscle mass are lost. Humans experience a similar loss under certain conditions on Earth. Bone and muscle loss exist on Earth as humans age from adulthood to senescence, during limb immobilization for healing of orthopedic injuries, during wheelchair confinement because of certain diseases, and during chronic bed rest prescribed for curing of diseases. NASA-sponsored research is dedicated to learning both what cause bone and muscle loss as well as finding out how to prevent this loss. The health ramifications of these discoveries will have major impact. Objective 1.6 of Healthy People 2000, a report from the U.S. Department of Health and Human Services, states that the performance of physical activities that improve muscular strength, muscular endurance, and flexibility is particularly important to maintaining functional independence and social integration in older adults. This objective further states that these types of physical activities are important because they may protect against disability, an event which costs the U.S. economy huge sums of money. Thus NASA research related to bone and muscle loss has potential major impact on the quality of life in the U.S. Relative to its potential health benefits, NASA and Congress-

sional support of bone and muscle research is funded is a very low level.
Author (Hemer)

A95-60678* National Aeronautics and Space Administration, Washington, DC.

MICROGRAVITY EFFECTS ON 'POSTURAL' MUSCLE ACTIVITY PATTERNS

CHARLES S. LAYNE KRUG Life Sciences, Houston, TX, US and BRIAN S. SPOONER Kansas State Univ., Manhattan, KS, US *Advances in Space Research* (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)381-(8)384 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992.

(Contracts NAGW-2328; NAGW-1197)
(ISBN 0-08-042485-6) Copyright

Changes in neuromuscular activation patterns associated with movements made in microgravity can contribute to muscular atrophy. Using electromyography (EMG) to monitor 'postural' muscles, it was found that free floating arm flexions made in microgravity were not always preceded by neuromuscular activation patterns normally observed during movements made in unit gravity. Additionally, manipulation of foot sensory input during microgravity arm flexion impacted upon anticipatory postural muscle activation.

Author (Hemer)

A95-60680

UNUSUAL VISUAL STIMULATION IN DYNAMIC BALANCE CONDITIONS: PROPOSAL FOR A SPACE MOTION SICKNESS TEST

ALEXANDRA SEVERAE Univ. Paul Sabatier, Toulouse, France, PAUL BESSOU Univ. Paul Sabatier, Toulouse, France, and BERNARD PAGES Univ. Paul Sabatier, Toulouse, France *Advances in Space Research* (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)389-(8)394 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. Research sponsored by CNES (Centre National d'Etudes Spatiales), DASSAULT AVIATION (France) and Fondation pour la Recherche Medicale
(ISBN 0-08-042485-6) Copyright

We previously demonstrated the efficiency of normal vision/unusual vestibular cues conflict to induce motion sickness. In the present study, we investigate whether, inversely, unusual visual information/normal vestibular function conflict also elicited motion sickness. The experiments were again carried out in dynamic balance conditions to increase proprioceptive input. Circular translation of the visual field with diplopia were produced by rotating Fresnel prismatic glasses. The stimulation triggered Space Motion Sickness (SMS)-like symptoms and dynamic balance disturbance. A positive relationship was found between discomfort and balance disturbance. Unusual visual information should therefore be included in Space Motion Sickness susceptibility testing.

Author (Hemer)

A95-60681* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

THE RHESUS MONKEY AS A MODEL FOR TESTING THE IMMUNOLOGICAL EFFECTS OF SPACE FLIGHT

G. SONNENFELD Univ. of Louisville, Louisville, KY, US, L. SCHAFFAR Assoc-France de Lutte Cont. la Mucov, Paris, France, D. A. SCHMITT CHU de Toulouse-Rangueil, Toulouse, France, C. PERES CHU de Toulouse-Rangueil, Toulouse, France, and E. S. MILLER Univ. of Louisville, Louisville, KY, US *Advances in Space Research* (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)395-(8)397 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. (Contracts NAG2-624; NAG2-707; CNES-268; CNES-297)
(ISBN 0-08-042485-6) Copyright

The Rhesus monkey has been proposed as a model for the

effects of space flight on immunity. In order to determine the feasibility of the use of the Rhesus monkey as a model, we studied the use of Rhesus monkey cells for immunological procedures that have been shown to be affected by space flight in both rodents and humans. We have shown that both lymph node cells and peripheral blood leukocytes can be stained with monoclonal antibodies to detect the following surface markers: CD4, CD-8, Ia and surface immunoglobulin. Also, the level of Ia antigen expression was increased by treatment of the cells with human interferon-gamma. In addition, cells were induced to produce interferons and interleukins. Isolated neutrophils also demonstrated increased oxidative burst. These data indicate that the Rhesus monkey will be a useful model for space flight studies of immunity.
Author (Hemer)

A95-60683

ARTIFICIAL GRAVITY AS A COUNTERMEASURE OF PHYSIOLOGICAL DECONDITIONING IN SPACE

DAVID CARDUS Baylor College of Medicine, Houston, TX, US and WESLEY G. MCTAGGART Baylor College of Medicine, Houston, TX, US *Advances in Space Research* (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)409-(8)414 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992.

(ISBN 0-08-042485-6) Copyright

The displacement of humans from our planet to space and back to our planet or to another planet necessarily causes the exposure to transitional gravitational forces which create a need for countermeasures of physiological deconditioning. One of the alternative approaches to counteracting physiological deconditioning is the simulation of a gravitational field. An apparatus named the artificial gravity simulator (AGS) has been designed and constructed. The AGS is a short radius rotating platform capable of producing a +Gz 100% gradient of a variable magnitude up to 3-g. It supports four beds for testing four subjects at a time. The AGS is suitable for short and long duration experiments on various physiological systems. At present it is being used to study the cardiovascular response to various g-levels and exposure times.
Author (Hemer)

A95-60684

ETHOLOGICAL EXPERIMENTS ON HUMAN ORIENTATION BEHAVIOR WITHIN A THREE-DIMENSIONAL SPACE-IN MICROGRAVITY

C. TAFFORIN Universite Paul Sabatier, Toulouse, France and R. CAMPAN Universite Paul Sabatier, Toulouse, France *Advances in Space Research* (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)415-(8)418 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Washington, DC, Aug. 28-Sep. 5, 1992. Research sponsored by CNES, the Conseil Regional de Midi-Pyrenees, and the CNRS URA
(ISBN 0-08-042485-6) Copyright

In weightlessness situation the subject has to realize domestic and professional tasks comparable to those performed under normal gravity, whereas the 'body tool' available to him has been placed in new conditions which require significant behavioral changes. The loss of weight, the disappearance or modification of some ideothetic and allothetic cues, notably the absence of gravity for the body's referential verticality have the most obvious effect of diversifying the astronaut's orientations. The vertical position is thus no longer the only one possible. This means that in order to efficiently accomplish his tasks, the subject has to invent new motor strategies which transform the quality of displacements and manipulations on the basis of the new orientation possibilities in a three-dimensional space.
Author (Hemer)

A95-60686

OVERWINTERING IN THE ANTARCTICA AS AN ANALOG FOR LONG TERM MANNED SPACEFLIGHT

M. TANAKA Nagoya Univ., Chikusa, Nagoya, Japan and S. WATANABE Nagoya Univ., Chikusa, Nagoya, Japan *Advances*

in Space Research (ISSN 0273-1177) vol. 14, no. 8 August 1994 p. (8)423-(8)430 Life sciences and space research 25 (1). Gravitational biology; Interdisciplinary Scientific Commission F of the COSPAR Plenary Meeting, 29th, Wash., DC, Aug. 28-Sep. 5, 1992. (ISBN-0-08-042485-6) Copyright

As a part of Polar Psychological Project planned by Scientific Committee of Antarctic Research (SCAR) group on Antarctic-Space-Related-Human-Factors-Research, a series of psychological tests were conducted on the Japanese wintering-over personnel. The main purpose of the research was to study the behavioral characteristics, such as depression, insomnia, anxiety, and hostility, which might develop during the course of wintering-over period, and it involves a detailed study of the individuals and interpersonal relationship. Author (Herner)

N95-10024* Old Dominion Univ., Norfolk, VA. Dept. of Electrical and Computer Engineering.

A PORTABLE FETAL HEART MONITOR AND ITS ADAPTION TO THE DETECTION OF CERTAIN PRENATAL ABNORMALITIES Final Report, period ending 31 Oct. 1993

STEPHEN A. ZAHORIAN Jul. 1994 13 p
(Contract NCC1-164)

(NASA-CR-196430; NAS 1.26:196430) Avail: CASI HC A03/MF A01

There were three primary objectives for this task: (1) The investigation of the feasibility of making the fetal heart rate monitor portable, using a laptop computer; (2) Improvements in the signal processing for the monitor; and (3) Implementation of a real-time hardware software system. These tasks have been completed as discussed in the following section. Derived from text

N95-10221# Bracken (T. Dan), Inc., Portland, OR.

ELECTRIC AND MAGNETIC FIELDS IN A MAGNETIC RESONANCE IMAGING FACILITY: MEASUREMENTS AND EXPOSURE ASSESSMENT PROCEDURES

T. DAN BRACKEN 24 Feb. 1994 100 p
(Contract NIOSH-9239540)

(PB94-174489) Avail: CASI HC A05/MF A02

A pilot study was conducted to test protocols for assessing exposure to magnetic and electric fields among workers at magnetic resonance imaging (MRI) facilities. Static magnetic fields, pulsed gradient fields, pulsed radio frequency electric and magnetic fields, and extremely low frequency, very low frequency, and low frequency magnetic fields were measured in an MRI facility. Hall effect sensors were used to measure the static field, and air core induction coils were used to measure the power frequency magnetic fields. The static field measurements in the facility corresponded well with the contours provided by the system manufacturer, confirming that static field exposures can be estimated by combining manufacturers' data with time/motion analysis. Time spent near the magnetic face clearly dominates the exposure estimates. The author suggests that additional study be done to compare the time motion estimates of exposure with dosimeter measurements, to characterize gradient fields for different imaging protocols, and to evaluate the use of MRI facility records, such as procedure log books, to estimate exposure. NTIS

N95-10243# Polish Academy of Sciences, Warsaw (Poland). Inst. of Basic Problems of Technology.

THE USE OF ACOUSTIC EMISSION IN ORTHOPEDICS [ZASTOSOWANIE EMISJI AKUSTYCZNEJ W ORTOPEDII] ZBIGNIEW SWIECKI (Wroclaw Polytechnic Electronic Engineering Inst., Poland.) and JERZY RANACHOWSKI 1993 26 p In POLISH

(ISSN 0208-5658) Avail: CASI HC A03/MF A01

This article discusses the basic measurement parameters and instruments for detecting acoustic emission. The authors describe fracture mechanisms for brittle materials in relation to human bone as a structural material. The authors present the characteristics of the acoustic emission generated by mechanical stresses of human bones. The results presented pertain to animal research and dem-

onstrate the possibility of using acoustic emission techniques in orthopedics. Transl. by SCITRAN

N95-10533# Texas Univ., Houston, TX.

THEORETICAL MODELING OF OCULAR TISSUE DAMAGE BY SHORT PULSE LASER Annual Technical Report, 15 Apr. 1993 - 14 Apr. 1994

STEVEN L. JACQUES 27 May 1994 6 p

(Contract F49620-93-1-0298)

(AD-A280928; AFOSR-94-0385TR) Avail: CASI HC A02/MF A01

The effects of short pulsed lasers in ocular tissues involve both thermal and mechanical damage. In the past year of study we have examined the literature values for the threshold radiant exposure causing 'minimal visible lesion.' In particular, the threshold exposures for short pulses in the sub-100-ps regime were examined. Two possible mechanisms of mechanical damage in the retina were considered: (1) melanosomal disruption and (2) shock front development. DTIC

N95-10550* National Aeronautics and Space Administration, Washington, DC.

SPACELAB LIFE SCIENCES-1 (Videotape)

Aug. 1991 Videotape: 3 min. 53 sec. playing time, with sound (NASA-TM-109873; NONP-NASA-VT-94-23142) Avail: CASI VHS A01/BETA A22

STS-40, carrying Spacelab Life Sciences-1, was the first dedicated to study the human body in microgravity. Experiments regarding adaptation to space and readaptation to the world of gravity are discussed in this video. Spacelab is another precursor to long-term science aboard the space station. CASI

N95-10551* National Aeronautics and Space Administration, Washington, DC.

AIRCRAFT TO MEDICINE (Videotape)

Dec. 1991 Videotape: 3 min. 5 sec. playing time, with sound (NASA-TM-109245; NONP-NASA-VT-94-23143) Avail: CASI VHS A01/BETA A22

This video discusses how the technology of computer modeling can improve the design and durability of artificial joints for human joint replacement surgery. Also, ultrasound, originally used to detect structural flaws in aircraft, can also be used to quickly assess the severity of a burn patient's injuries, thus aiding the healing process. CASI

N95-10562* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

TELEMEDICINE SPACEBRIDGE (Videotape)

May 1994 Videotape: 6 min. 44 sec. playing time, with sound (NASA-TM-109923; NONP-NASA-VT-94-23165) Avail: CASI VHS A01/BETA A22

This video is an overview on NASA's Telemedicine Spacebridge Project, which lets US doctors consult with Russian clinicians thousands of miles away by demonstration of the feasibility of live, two-way, full-bandwidth video as a medical tool. LeRC

N95-10861* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

CREW FACTORS IN FLIGHT OPERATIONS 6: PSYCHOPHYSIOLOGICAL RESPONSES TO HELICOPTER OPERATIONS

PHILIPPA H. GANDER (San Jose State Univ., CA.), RORY M. BARNES (Civil Aviation Authority, London, England.), KEVIN B. GREGORY (Sterling Software, Inc., Palo Alto, CA.), LINDA J. CONNELL, DONNA L. MILLER, and R. CURTIS GRAEBER Jul. 1994 44 p

(Contract RTOP 505-64-53)

(NASA-TM-108838; A-94113; NAS 1.15:108838) Avail: CASI HC A03/MF A01

Thirty-two helicopter pilots were studied before, during, and after 4-5 day trips providing support services from Aberdeen, Scotland, to rigs in the North Sea oil fields. Early on-duty times obliged

subjects to wake up 1.5 hours earlier on trip days than on pretrip days. Consequently, they slept nearly an hour less per night on trips. They reported more fatigue on post-trip days than on pretrip days, suggesting a cumulative effect of duty-related activities and sleep loss. Fatigue and negative affect were higher, and activation lower, by the end of trip days than by the end of pretrip days. The earlier a subject went on duty, the lower his activation by the end of the day. Caffeine consumption increased 42 percent on trip days. The incidence of headache doubled, of back pain increased twelve fold, and of burning eyes quadrupled. In the aircraft studied, thermal discomfort and high vibration levels were common. The longer pilots remained on duty, the more negative their mood became.

Author

N95-10937*# New Jersey Medical School, Newark, NJ.
**MEDICAL AND SURGICAL EVALUATION AND CARE OF
 ILLNESS IN SPACE Final Report, Apr. 1992 - May 1994**
 JOHN H. SIEGEL 1994 35 p Original contains color illustrations
 (Contract NAG9-567)
 (NASA-CR-196280; NAS 1.26:196280) Avail: CASI HC A03/MF
 A01; 12 functional color pages

This report summarizes the work done on the contract NAG9-567, which was activated at the New Jersey Medical School-UMDNJ in April 1992 and carried on during the 1992-93 year to the present 1993-94 year which was terminated in May 1994. The initial examination stage was completed of an interactive program for the recording of physical and physiologic injury information obtained from examination of an injured person, who might be an astronaut sustaining traumatic injury, due to a burn or physical trauma, either in space or in an earth bound training environment. In this report three aspects will be discussed: 1) a description of the system of diagnostic examination graphics, 2) a description of the organization of the therapeutic advisory systems with a demonstration of two specific modules, and 3) a brief technical description of the organization of the programming system carried out on a UNIX based workstation using a WINDOWS environment. Derived from text

N95-11250*# Texas Univ., Austin, TX. Dept. of Mechanical Engineering.
**DEVELOPMENT AND EVALUATION OF A MUSCULO-
 SKELETAL MODEL OF THE ELBOW JOINT COMPLEX**
 ROGER V. GONZALEZ, E. L. HUTCHINS, RONALD E. BARR, and
 LAWRENCE D. ABRAHAM 1993 29 p
 (Contracts NAG9-588; NGT-70252)
 (NASA-CR-196160; NAS 1.26:196160) Avail: CASI HC A03/
 MF A01

This paper describes the development and evaluation of a musculoskeletal model that represents human elbow flexion-extension and forearm pronation-supination. The length, velocity, and moment arm for each of the eight musculotendon actuators were based on skeletal anatomy and position. Musculotendon parameters were determined for each actuator and verified by comparing analytical torque-angle curves with experimental joint torque data. The parameters and skeletal geometry were also utilized in the musculoskeletal model for the analysis of ballistic elbow joint complex movements. The key objective was to develop a computational model, guided by parameterized optimal control, to investigate the relationship among patterns of muscle excitation, individual muscle forces, and movement kinematics. The model was verified using experimental kinematic, torque, and electromyographic data from volunteer subjects performing ballistic elbow joint complex movements.

Author

N95-11337# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
**AGE-RELATED CHANGES IN SYMPATHETIC-ADRENAL
 MEDULLARY FUNCTION: RELATIONSHIP TO AGE-
 RELATED DEFICITS IN LEARNING AND MEMORY Ph.D.
 Thesis**

THOMAS R. MABRY Aug. 1994 213 p
 (AD-A282122; AFIT/CI/CIA-94-089) Avail: CASI HC A10/MF A03

This dissertation examined the contribution of age-related changes in sympathetic-adrenal medullary (SAM) functioning to age-related deficits in cognitive processes. Two experiments involved parametric studies within a stimulus class to characterize more fully age-related differences in plasma catecholamine (CA) responses to acute stress. Results from the footshock experiment revealed that aged male F-344 rats have potentiated plasma CA responses to handling and transfer during placement in an inhibitory (passive) avoidance testing apparatus. Aged rats may exhibit decrements in retention because the saliency of low intensity footshock is masked by the effects of handling and transfer immediately before and after the training experience. Aged rats had potentiated plasma CA responses and delayed returns to basal levels compared to young adults to higher footshock intensities. Aged rats displayed altered SAM responsiveness to swim stress in a temperature-dependent manner. Aged rats exhibited comparable SAM responsiveness to swim stress at 35 deg C. Similar peak responsiveness for rats of both ages was also found at 20 deg C; however, aged animals exhibited a prolonged recovery to basal values. At intermediate temperatures, aged animals had both potentiated peak plasma EPI responses and a prolonged recovery to basal values. DTIC

N95-11338# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
**THE EFFECTS OF VARIOUS QUALITY POLARIZED LENSES
 ON COLOR VISION, STEREOPSIS, VISUAL ACUITY, AND
 CONTRAST SENSITIVITY Ph.D. Thesis**
 TYLER O. CATES, JAMES A. DAVIS, and SERGIO A. GUZMAN
 May 1994 22 p

(AD-A282125; AFIT/CI/CIA-94-060) Avail: CASI HC A03/MF A01
 Polarized sunglasses are commonly used for glare reduction in tasks such as driving and in outdoor recreation such as fishing. These glasses are produced by many manufacturers and offered at a widely variable expense to the consumer. Studies of visual performance changes from plain tinted sunglasses including visual acuity, contrast sensitivity, stereopsis, and color discrimination have been completed in the past, but these factors have not been studied with tinted polarized lenses. In this study, three groups of polarized sunglasses were assembled based on relative retail prices. The results of this study indicate that tinted polarized lenses affect the same chances that plain tinted lenses do, and the least expensive lenses were found to perform as well or better than the more expensive lenses in these four visual performance categories. DTIC

N95-11405* National Aeronautics and Space Administration, Washington, DC.

**AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING
 BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 393)**
 Oct. 1994 25 p
 (NASA-SP-7011(393); NAS 1.21:7011(393)) Avail: CASI HC A03

This bibliography lists 29 reports, articles and other documents introduced into the NASA Scientific and Technical Information System during Oct. 1994. Subject coverage includes: aerospace medicine and physiology, life support systems and man/system technology, protective clothing, exobiology and extraterrestrial life, planetary biology, and flight crew behavior and performance.

Author

N95-11594*# Utah Univ., Salt Lake City, UT. Div. of Radiobiology.
**PREVENT AND CURE DISUSE BONE LOSS Final Technical
 Report, Mar. 1990 - Feb. 1994**
 WEBSTER S. S. JEE 13 Sep. 1994 14 p
 (Contract NAG2-435)
 (NASA-CR-196845; NAS 1.26:196845) Avail: CASI HC A03/
 MF A01

Anabolic agents like parathyroid hormone and postagladin E-like substances were studied in dogs and rats to determine their effectiveness in the prevention and cure of bone loss due to

immobilization. It was determined that postgladin E2 administration prevented immobilization while at the same time it added extra bone in a dose responsive manner. Although bone mass returns, poor trabecular architecture remains after normal ambulation recovery from immobilization. Disuse related bone loss and poor trabecular architecture were cured by post-immobilization postgladin E2 treatment. CASI

N95-11608 Toronto Univ. (Ontario). School of Physical and Health Education.

STRENGTH TRAINING AS A COUNTER-MEASURE FOR MICROGRAVITY EFFECTS

R. D. FORSYTH, M. J. PLYLEY, W. R. RHODES, N. MCKEE, and J. HARTLEY. In McGill Univ., Second International Design for Extreme Environment Assembly (IDEEA Two). Growth and Environment: Challenging Extreme Frontiers p 223-230 1994 Copyright Avail: Issuing Activity (Centre for Northern Studies and Research, McGill Univ., 805 Sherbrooke Street West, Montreal, Quebec, H3A 2K6, Canada)

Our team has been investigating the utility of exercise as a counter-measure to the effects of microgravity on muscle and bone. Though our research is still incomplete, our preliminary findings show that muscle force strength can be maintained by isometric exercise. The results of past research support the hypothesis that exercise can be useful as a counter-measure to the effects of microgravity. However, much research needs to be carried out to investigate the type, amount and nature of this exercise. Furthermore, techniques and approaches to supplying this exercise in space station or spacecraft environment must be well researched before being committed to a particular space program. Weight, size and simplicity of operation are major design constraints that must drive the hardware and software development for such an exercise system. The body's response to long term microgravity effects include many physiological changes. Bone determination and muscle atrophy are two of these changes. This presentation deals with the effects of microgravity on bone and muscle composition, and the way in which exercise can alleviate these problems. The authors of this presentation propose that the methods for controlling the effects of microgravity on bone and muscle must be developed now. Research must be focussed on whether the effects of microgravity on bone degradation are permanent or are reversible. The health and well being of humans returning from extended stays in space must be a top priority. Hence, this presentation describes a proposed system for use in space to reduce or eliminate the effects of microgravity on human bone and muscle tissue. Our presentation will look at the history of exercise systems used for counter-acting microgravity. We will illustrate the strengths and weaknesses we perceive as important to the development of such systems. We will examine the physiological processes and consequences of exercise in microgravity. Finally, we will outline proposed methods and techniques that could be used on the space station and for spacecraft bound for Mars. Author

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BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

A95-60105* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

JUDGING ROLLING WHEELS: DYNAMIC AND KINEMATIC ASPECTS OF ROTATION-TRANSLATION COUPLING

HEIKO HECHT NASA, Ames Research Center, Moffett Field, CA, US Perception (ISSN 0301-0066) vol. 22 1993 p. 917-928 (HTN-94-00359) Copyright

Four experiments were carried out to investigate observers'

abilities to judge rolling motions. The experiments were designed to assess whether two important aspects of such motions are appreciated: the kinematic coupling of rotation and translation, and the dynamic effects of gravity. Different motion contexts of rolling wheels were created using computer-generated displays. The first experiment involved wheels rolling down an inclined plane. Observers spontaneously appreciated the anomaly of wheels that failed to accelerate, but they were not able to differentiate between different acceleration functions. Moreover, their judgements were almost exclusively based on the translation component of the rolling motion, neglecting the rotation component. In a second experiment it was found that observers could accurately estimate the perimeter of various objects. Thus, their inability to consider rotation information is not attributable to misperceptions of the geometry of wheels. In a third experiment the finding that rolling wheels appear to overrotate was replicated; however, findings from this experiment also showed, together with those from a fourth experiment, that observers are able to make very accurate judgments about translation-rotation coupling in rolling wheels when information is provided about the orientation of the wheel and the texture of the surface on which it rolls.

Author (Hemer)

A95-60116* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

STEREOKINETIC EFFECT AND ITS RELATION TO THE KINETIC DEPTH EFFECT

DENNIS R. PROFFITT Univ. of Virginia, Charlottesville, VA, US, HEIKO HECHT Univ. of Virginia, Charlottesville, VA, US, IRVIN ROCK Univ. of California, Berkeley, CA, US, and JIM SCHUBERT Rutgers Univ., New Brunswick, NJ, US Journal of Experimental Psychology: Human Perception and Performance (ISSN 0096-1523) vol. 18, no. 1 1992 p. 3-21 (Contracts AFOSR-91-0057; NCA2-468; NIMHRSA-K05MH00707) (HTN-94-00393) Copyright

The stereokinetic effect (SKE) has been defined and studied by nested circular patterns rotating on a turntable. Circles must appear not to rotate as they revolve, which in turn results in their appearing to translate relative to one another. A powerful illusion of object depth results even though the individual circles do not undergo an appropriate foreshortening consistent with their apparent changes in slant. It is suggested and tested that the SKE is based on the changing positions between the nested contours despite the absence of any change within each contour, whereas the kinetic depth effect (KDE) entails both kinds of change. It follows that a turntable method of presentation is not necessary, and between-contour transformations can be simulated by computer animation. Displays consisting of simple translations were shown to evoke robust depth impressions as were patterns consisting of contours of varying shapes. Comparisons of the depth, compellingness, and rigidity of matched SKE and KDE displays are reported. The SKE is taken to be paradigmatic for how the visual system perceives depth when observing small object rotations that occur in everyday situations. Author (Hemer)

A95-60122* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

APPARENT EXTENDED BODY MOTIONS IN DEPTH

HEIKO HECHT Univ. of Virginia, Charlottesville, VA, US and DENNIS R. PROFFITT Univ. of Virginia, Charlottesville, VA, US Journal of Experimental Psychology: Human Perception and Performance (ISSN 0096-1523) vol. 17, no. 4 1991 p. 1090-1103 (Contracts AFOSR-87-0238; NCA2-255; NCA2-468) (HTN-94-00400) Copyright

Five experiments were designed to investigate the influence of three-dimensional (3-D) orientation change on apparent motion. Projections of an orientation-specific 3-D object were sequentially flashed in different locations and at different orientations. Such an occurrence could be resolved by perceiving a rotational motion in depth around an axis external to the object. Consistent with this proposal, it was found that observers perceived curved paths in depth. Although the magnitude of perceived trajectory curvature

often fell short of that required for rotational motions in depth (3-D circularity), judgments of the slant of the virtual plane on which apparent motions occurred were quite close to the predictions of a model that proposes circular paths in depth. Author (Hemer)

A95-60124

INTEGRATION OF LOCAL FEATURES AS A FUNCTION OF GLOBAL GOODNESS AND SPACING

MARIA I. LASAGA Univ. of Virg., Charlottesville, VA, US and HEIKO HECHT Univ. of Virg., Charlottesville, VA, US Perception & Psychophysics (ISSN 0031-5117) vol. 49, no. 3 1991 p. 201-211

(HTN-94-00404) Copyright

In two experiments, the accuracy with which subjects detected a conjunction of features was examined as a function of the spacing between items and the goodness of the axis along which they were located. In each array, two items were arranged along a vertical, a horizontal, or a diagonal axis. Based on the well-established oblique effect, the vertical and horizontal axes were considered to be good global patterns and the diagonals were considered to be poor. In Experiment 1, the two items in an array could be two horizontal lines, two vertical lines, a vertical and a horizontal line, or a plus sign with one of the single lines. In Experiment 2, a positive- and a negative-diagonal line were used as the individual features, and an 'X' was used as the conjunction. The results from Experiment 1 indicated that global goodness influenced only the rate of illusory conjunctions, and not of feature errors. Illusory conjunctions of vertical and horizontal line segments were more likely to occur in vertical and horizontal arrangements. The results from Experiment 2 revealed a reversal of the effect of global goodness on the rate of illusory conjunctions: Illusory conjunctions of negative- and positive-diagonal line segments were more likely to occur in diagonal arrangements. The results of both experiments taken together showed the existence of an important and new factor that influences the likelihood that features of shape will be conjoined: the ease with which line segments conjoin when they are translated along their extent toward each other. In both experiments, greater spacing between items produced more feature-identification errors and fewer feature-integration errors than did less spacing. Author (Hemer)

A95-60127* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

ON THE EXTERNALIZATION OF AUDITORY IMAGES

N. I. DURLACH Mass. Inst. of Tech., Cambridge, MA, US, A. RIGOPULOS Mass. Inst. of Tech., Cambridge, MA, US, X. D. PANG Mass. Inst. of Tech., Cambridge, MA, US, W. S. WOODS Boston Univ., Boston, MA, US, A. KULKARNI Boston Univ., Boston, MA, US, H. S. COLBURN Boston Univ., Boston, MA, US, and E. M. WENZEL NASA Ames Research Center, Moffett Field, CA, US Presence (ISSN 1054-7460) vol. 1, no. 2 Spring 1992 p. 251-257

(Contracts AFOSR-90-0200; NIH-RO1 DC00100)

(HTN-94-00407) Copyright

An acoustic image is said to be 'externalized' if the sound source appears to the listener to lie outside the head. The purpose of the note is to put the phenomenon of externalization of auditory images in proper perspective. It points out that the listener's pinnae (the so-called 'pinna factor') is only one of many factors that determine the extent to which a sound image is externalized and that the relative importance of these factors is not yet clear. The note begins with some general comments on externalization. It then considers the effect of reverberation. It examines head movements, visual effects, and other factors. It concludes with remarks on externalization's relation to head-related transfer functions (HRTFs), the pinna factor, and improved experimental instrumentation.

Author (Hemer)

N95-10144# Federal Aviation Administration, Oklahoma City, OK. Civil Aeromedical Inst.

RELATIONSHIPS OF TYPE A BEHAVIOR WITH BIOGRAPHICAL CHARACTERISTICS AND TRAINING

PERFORMANCE OF AIR TRAFFIC CONTROLLERS Final Report

L. G. NYE, D. J. SCHROEDER, and C. S. DOLLAR Jul. 1994 12 p

(DOT/FAA/AM-94/13) Avail: CASI HC A03/MF A01

While there has been a considerable amount of research concerning the relationships between various cognitive measures and the selection and subsequent performance of Air Traffic Control Specialists (ATCSs), data concerning the potential importance of personality factors are quite limited. As part of an expanded research program, selected personality measures and biographical questionnaires have been administered to ATCSs at the time of their entry into the FAA Academy Nonradar Screen Program. A considerable body of research surrounds the Jenkins Activity Survey (JAS) as a measure of Type A behavior, coronary proneness, and other health problems. More recently, a revised JAS scoring procedure has been developed for Achievement Striving (AS) and Impatience-Irritability (II) scales; those scales have been significantly and differentially related to job performance, academic achievement, job satisfaction, and negative affect (e.g., depression). The JAS and a biographical questionnaire were administered to 474 ATCS students at the beginning of the nine-week screening program. Scores on the traditional JAS AS, and II scales were compared with measures of FAA Academy performance, and attitudinal and biographical data. Analyses of the JAS questions confirmed the presence of the AS and II factors. In contrast to previous research, which documented a positive relationship between AS and academic achievement in college, correlations between AS and Academy achievement were non-significant. It may be that in less academic settings, achievement striving is a relatively less important predictor of training success compared to specialized cognitive abilities. The AS scores were significantly correlated with self-reported expectations of job performance and satisfaction. II scores were related to a number of life style behaviors, including alcohol consumption. Results provide further evidence in support of the existence of the AS and II dimensions of the JAS. Concurrent validity of the two components with the criterion measures was partially supported in the present setting. Given the historical use of the JAS and current support for the existence of the new scales, longitudinal studies could examine the effectiveness of the JAS in predicting both the long-term job success of air traffic controllers and prospective health-related problems that might arise. Author

N95-10236 Helsinki Univ. of Technology, Espoo (Finland). Power Systems and Illumination Engineering Lab.

EFFECTS OF LIGHTING AND TASK PARAMETERS ON VISUAL ACUITY AND PERFORMANCE Ph.D. Thesis

L. HALONEN 17 Dec. 1993 172 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (PB94-179231; ISBN-951-22-1845-3) Avail: CASI HC A08

Lighting and task parameters and their effects on visual acuity and visual performance are dealt with. The parameters studied are target contrast, target size, and subject's age; also, adaptation luminance, luminance ratio between task and its surrounding, and temporal change in luminances are studied. Experiments were carried out to examine the effects of luminance and light spectrum on visual acuity. Young normally sighted, older, and low vision people participated in the measurements. On the basis of the visual acuity experiments, a three dimensional visual acuity model (VA-HUT) has been developed. The model predicts visual acuity as a function of luminance, target contrast, and observer age. On the basis of visual acuity experiments visual acuity reserve values have been calculated for different text sizes. Luminance measurements were carried out in an office room with and without daylight. When the lighting or task parameters are near the threshold values, a very small increase in the values improves performance. However, when the values are above a certain value there is unlikely to be any significant improvements in visual acuity or visual performance.

NTIS

53 BEHAVIORAL SCIENCES

N95-10536# Minnesota Univ., Minneapolis, MN. Dept. of Psychology.
COGNITIVE/SELF-REGULATORY APTITUDES AND INSTRUCTIONAL METHODS FOR COMPLEX SKILL LEARNING Annual Technical Report, 1 Mar. 1993 - 28 Feb. 1994

PHILLIP L. ACKERMAN and RUTH KANFER 26 May 1994 10 p
(Contract F49620-93-1-0206)
(AD-A280937; AFOSR-94-0371TR) Avail: CASI HC A02/MF A01

The research described in the proposal has continued on-track and on-schedule. To date three major studies have been completed, and are in various phases of write-up and submission for publication. The studies are: (1) validation of a theoretical taxonomy of perceptual speed abilities; (2) a study of part-task training and aptitude-treatment interactions in transfer of training; and (3) a study of the ability and self-regulatory aptitude components of asymptotic skills. In addition, completion work is taking place on the ability and volitional components of knowledge acquisition in an associative memory/substitution task. No significant impediments to the progress of the project have been encountered. DTIC

N95-11340# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
EXAMINATION OF THE PROCESSES UNDERLYING MULTILEVEL EFFICACY-PERFORMANCE SPIRALS: A FLIGHT SIMULATION STUDY Ph.D. Thesis
DANA H. LINDSLEY Aug. 1994 230 p
(AD-A282136; AFIT/CI/CIA-94-092) Avail: CASI HC A11/MF A03

A dynamic multilevel model of the relationships between efficacy, causal attributions, affect and performance at the individual and team level of analysis was tested using a PC-based flight and combat jet simulator and 102 Air Force Recruit Officer Training Corp (AFROTC) cadets (51 dyads). The impact that performance, causal attributions, and affect have on subsequent individual and team efficacy and subsequent performance over-time were investigated. These relationships were examined twice at the individual level of analysis (one per teammate) and once at the team level of analysis. In addition, the relationship between individual efficacy and performance, and collective (team) efficacy and performance were observed over four trials. Finally, the compositional and cross-level effects of individual and team efficacy and performance were explored. Results suggest initial support for the multilevel efficacy-performance spiral model, and the influences of causal attributions and affect on this dynamic model. A summary of the findings, the perceived strengths and limitations of this study, suggestions for future research, and applied considerations are outlined. DTIC

N95-11421# Naval Health Research Center, San Diego, CA.
DIFFERING EVENT-RELATED PATTERNS OF GAMMA-BAND POWER IN BRAIN WAVES OF FAST-AND SLOW-REACTING SUBJECTS Final Report
HENNRIC JOKEIT and SCOTT MAKEIG May 1994 14 p
(AD-A281693; NHRC-94-9) Avail: CASI HC A03/MF A01

Fast- and slow-reacting subjects exhibit different patterns of circa 40 Hz-band electroencephalogram (EEG) activity when responding as quickly as possible to auditory stimuli. This result appears to confirm long-standing speculations of Wundt that fast- and slow-reacting subjects produce speeded reactions in different ways, and demonstrates that analysis of event-related changes in the amplitude of EEG activity recorded from the human scalp can reveal information about event-related brain processes unavailable using event-related potential measures. Time-varying spectral power in a selected (35 to 43 Hz) gamma frequency band was averaged across trials in two experimental conditions: passive listening and speeded reacting to binaural clicks, forming 40 Hz event-related spectral responses. Factor analysis of between-subject event-related spectral response differences split subjects into two near-

equal groups comprised of faster- and slower-reacting subjects respectively. In faster-reacting subjects, 40 Hz power peaked near 200 and 400 ms poststimulus in the react condition, whereas in slower-reacting subjects, 40 Hz power just before stimulus delivery was larger in the react condition. These group differences were preserved in separate averages of relatively long and short reaction-time epochs for each group. Gamma band (20-60 Hz) filtered event-related potential response averages did not differ between the two groups or conditions. Because of this, and since gamma-band power in the auditory event-related potential is small compared to the EEG, the observed event-related spectral-response features must represent gamma-band EEG activity reliably induced by, but not phase-locked to experimental stimuli or events. DTIC

N95-11570# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
THE IMPACT OF COMBINED HEAT AND NOISE ON SHORT-TERM RETENTION M.S. Thesis
JOHN S. PARENT 1993 85 p

(AD-A281744; AFIT/CI/CIA-94-014) Avail: CASI HC A05/MF A01

This thesis reports on the impact of combined heat and noise on the performance of a short-term memory retention task with two levels of difficulty. Thirty-two males, ages 18 - 35, were exposed to four different treatment conditions during four one hour sessions. These four treatment conditions consisted of: a control environment, a noise environment, a heat environment, and a combined heat and noise environment. Temperatures during the control and noise conditions were maintained between 68 and 70 degrees Fahrenheit, while temperatures during the heat and combined conditions were maintained at 105 degrees Fahrenheit. Sound exposure levels during the noise and combined conditions averaged at 83.7 decibels with peak frequency exposures never exceeding 93.5 decibels for ten seconds. The task to be performed was a computerized version of game Concentration. Subjects were presented with both a 6 x 8 and an 8 x 8 grid of blank tiles and asked to correctly match as many tile pairs as they could in three minutes. DTIC

N95-11607 Allied-Signal Technical Services Corp., Houston, TX.
Employee Training.

DEVELOPING AN INTERNATIONAL ASTRONAUT TEAM

LARRY LIVINGSTON In McGill Univ., Second International Design for Extreme Environment Assembly (IDEEA Two). Growth and Environment: Challenging Extreme Frontiers p 214-222 1994 Copyright Avail: Issuing Activity (Centre for Northern Studies and Research, McGill Univ., 805 Sherbrooke Street West, Montreal, Quebec, H3A 2K6, Canada)

How do you develop an international astronaut team to live and work in a space station? This is a critical question that the International Space Station Partners must answer. The Space Station Freedom will continually be 'manned' with four to eight astronauts, selected from Canada, the European Space Agency, Japan, Russia, and the United States to perform specific science and/or payload task. Training by an assigned international crew to perform station specific task will be tightly controlled. Training schedules will dictate the crewmembers time. Training that is not directly related to the station carry low priority, and are continually rescheduled. Because of schedule constraints, traditional team building techniques, such as the Outward Bound team building experimental program, or the University of Michigan International Management Development course, requires too much time to complete, and may decrease the station skills already learned. This presentation will look at an alternative team building strategy, that can be used, without deviating station specific training. Also, this presentation will explore how team building techniques can be transferred to station specific training sessions. Author

N95-11620 Rice Univ., Houston, TX. Dept. of Psychology.
VARIABLES MEDIATING THE PERCEPTION OF CROWDING AND CONFINEMENT IN EXTREME ENVIRONMENTS
 ROMAN G. LONGORIA *In* McGill Univ., Second International Design for Extreme Environment Assembly (IDEEA Two). Growth and Environment: Challenging Extreme Frontiers p 400-411 1994 Copyright Avail: Issuing Activity (Centre for Northern Studies and Research, McGill Univ., 805 Sherbrooke Street West, Montreal, Quebec, H3A 2K6, Canada)

Research is abundant concerning the effects of isolation and confinement on individuals and teams working and living in extreme environments. While isolation and confinement have been categorized as being separate entities with separate effects, such a distinction is rarely made between confinement and crowding. Thus, attempts to quantify the effects of confinement and crowding have generally associated the two to form one all-encompassing environmental influence. The present discussion focuses on the need to disassociate confinement from social crowding and, in doing so, addresses mediating variables affecting individuals' perceptions of extreme environments. Individual differences are discussed as well as implications for training and selection. Author

N95-11621 Oxford Univ., Oxford (England). Architectural Psychology Lab.

COLOR AND PHYSIOLOGICAL AROUSAL

BYRON MIKELLIDES *In* McGill Univ., Second International Design for Extreme Environment Assembly (IDEEA Two). Growth and Environment: Challenging Extreme Frontiers p 412-417 1994 Copyright Avail: Issuing Activity (Centre for Northern Studies and Research, McGill Univ., 805 Sherbrooke Street West, Montreal, Quebec, H3A 2K6, Canada)

There is more to color than meets the eye and an account of some of the purported psychophysiological effects is given. The question of whether red is a more activating color than blue is discussed by reference to two opposing schools of thought. One is based on color light and measured by physiological changes in the central and autonomic nervous system and the other based on color pigment applied in interior and exterior spaces while carrying the dimensions of hue, chromatic strength, and lightness. Two experiments conducted recently at the Environmental Psychology Unit at Lund University are discussed where subjects experience realistic full scale red and blue spaces and where both physiological and affective measures are taken. Both practical and theoretical implications of this research will be discussed. Author

N95-11622 Ruhr Univ., Bochum (Germany). Dept. of Industrial/Organizational Psychology.

PSYCHOLOGICAL ASPECTS OF RISK TAKING IN EXTREME ENVIRONMENTS

RUEDIGER M. TRIMPOP *In* McGill Univ., Second International Design for Extreme Environment Assembly (IDEEA Two). Growth and Environment: Challenging Extreme Frontiers p 419-424 1994 Copyright Avail: Issuing Activity (Centre for Northern Studies and Research, McGill Univ., 805 Sherbrooke Street West, Montreal, Quebec, H3A 2K6, Canada)

Working in extreme environments is a form of risk-taking behavior people often choose voluntarily. Empirical studies presented in this paper show that people working in such settings generally score higher on risk-inclination and sensation seeking personality questionnaires. These people also tend to engage in other so called high-risk activities, such as mountain climbing, SCUBA-diving or motorcycling. Rewards for such behavior are in nature social (fame, praise), financial (risk-bonus, prize-money) and physiological (endorphine-release). Moreover, risk-taking behavior is not only rewarded but unavoidable and even required when working in extreme environments. It is unavoidable, because it is objectively impossible to predict all possible events occurring in that

environment. It is required to deal with uncertainties and to develop improvisation skills necessary for avoiding adverse consequences. Thus, in extreme situations any attempt to reduce risk taking behavior to a level close to zero is by definition impossible. Given such conditions, the control of risks becomes of utmost necessity as otherwise risk taking behavior would quickly lead to the extinction of risk-takers. Therefore, dealing with risks in extreme environments becomes a matter of risk-optimization and of developing risk-competence. Psychological studies revealed factors (e.g. intrinsic-extrinsic motivation, incentives, perceived control, level of participation) important for motivating individuals to show optimal risk taking behavior. The results, as discussed in risk-motivation theory and risk homeostatis theory, will be related to personnel selection, training, working individually, or in teams, and to organizational requirements necessary for designing extreme environments. Author

N95-11631 Suffolk Research Group, Inc., Dix Hills, NY.

LIGHT AND IMAGING IN EXTREME ENVIRONMENTS

STEPHEN MILES UZZO *In* McGill Univ., Second International Design for Extreme Environment Assembly (IDEEA Two). Growth and Environment: Challenging Extreme Frontiers p 623-645 1994 Copyright Avail: Issuing Activity (Centre for Northern Studies and Research, McGill Univ., 805 Sherbrooke Street West, Montreal, Quebec, H3A 2K6, Canada)

Humankind has striven for thousands of years to extend the capacity for the eye-brain system to sense, store and organize data. This is because, while the eye is capable of high acuity, the storage component of the system (brain) is unable to maintain accuracy and resolution over time. Images stored in the brain are modified due to individual neurological function, context, and experience, so a more objective medium is needed for scientific inquiry. One which allows a high degree of accuracy, objectivity and retrievability of image information to be achieved. Photography and electronic imaging (video) are filling that need. A further demand for the environmental scientist, is the ability to obtain high-quality images under conditions ranging from space to deep ocean trenches, and in terrestrial climates ranging from desert heat to Arctic cold. With the increased sophistication of remote sensing and image computing, images can be electronically captured and transmitted from unattended, teleoperated equipment for instant viewing, image processing, and mass storage. The purpose of this treatise is to examine the ways we extend our eye/brain system through a variety of imaging technologies in our race toward a sustainable world. Author

N95-11683# Civil Aeromedical Inst., Oklahoma City, OK.

BLINK RATE AS A MEASURE OF FATIGUE: A REVIEW Final Report

J. A. STERN, D. BOYER, and D. J. SCHROEDER Aug. 1994 14 p Prepared in cooperation with Washington Univ., Saint Louis, MO

(Contract DTFA02-91-C-91056)

(DOT/FAA/AM-94/17) Avail: CASI HC A03/MF A01

Fatigue is one of many factors that can impact the ability of pilots and air traffic controllers (ATC's) to maintain their performance across time. This review of the literature is an outgrowth of a study concerning the relationship between several gaze measures and time-on-task (TOT) performance of subjects on an ATC monitoring task. Blink rate is one of several psychophysiological measures that has been proposed to assess fatigue associated with TOT. The acrimonious debate between Luckiesh and Tinker and Bitterman is evaluated and that portion of Luckiesh's results dealing with increases in blink rate as a function of TOT is well substantiated by the results of most other investigations. Some evidence is presented that variables, other than TOT, also affect blink rate, as well as data suggesting that the nature of the blink (blink closure duration) may be affected by TOT effects. The development of improved methodologies for detecting attentional lapses or the impaired ability of operators to perform on perceptually and cognitively demanding tasks will allow us to conduct improved evaluations of the effectiveness of various fatigue countermeasures. Author

MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

A95-60150* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

THE NASA AMES CONTROLLED ENVIRONMENT RESEARCH CHAMBER - PRESENT STATUS

ANTHONY R. GROSS NASA. Ames Research Center, Moffett Field, CA, US, DAVID J. KORSMEYER NASA. Ames Research Center, Moffett Field, CA, US, LYNN D. HARPER NASA. Ames Research Center, Moffett Field, CA, US, and EDWIN L. FORCE NASA. Ames Research Center, Moffett Field, CA, US *In International Conference on Environmental Systems, 24th, and European Symposium on Space Environmental Central Systems 5th Friedrichshafen, Germany, June 20-23, 1994 Warrendale, PA Society of Automotive Engineers 1994 p. 1-9 (SAE-TP-941488; HTN-94-00454) Copyright*

The Controlled Environment Research Chamber (CERC) at the NASA Ames Research Center was created for early-on investigation of promising new technologies for life support of advanced space exploration missions. The CERC facility is being used to address the advanced technology requirements necessary to implement an integrated working and living environment for a planetary habitat. The CERC, along with a human-powered centrifuge, a planetary terrain simulator, advanced displays, and a virtual reality capability, is able to develop and demonstrate applicable technologies for future planetary exploration. There will be several robotic mechanisms performing exploration tasks external to the habitat that will be controlled through the virtual environment to provide representative workloads for the crew. Finally, there will be a discussion of innovative new multidisciplinary test facilities, and how effective they are to the investigation of the wide range of human and machine problems inherent in exploration missions. Author (Hemer)

N95-10728 Biodynamic Research Corp., San Antonio, TX. **MODELING RESPIRATORY GAS DYNAMICS IN THE AVIATOR'S BREATHING SYSTEM, VOLUME 1 Final Technical Report, May - Dec. 1993**

JOHN B. BOMAR, JR., MICHAEL W. SCOTT, and DARRIN A. SMITH May 1994 100 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (Contract F41624-93-C-6009)

(AD-A281250; AL/CF-TR-1994-0047-VOL-1) Avail: CASI HC A05

Biodynamic Research Corporation (BRC) completed an SBIR Phase 1 project to study the feasibility of developing a model of the Aviator's Breathing System (ABS). The motivation for the project was the desire to develop a model which could simulate the cardiovascular and respiratory responses to altitude and acceleration stress encountered in high performance military aircraft. Software modules were developed and tested for simulation of: (1) the flows and pressures within the breathing gas delivery system; (2) the flows, pressures, and gas distribution within the lung; and (3) the steady-state flows and pressures within the cardiovascular system. Subprograms were also developed to compute altitude barometric pressure relationships as well as passenger cabin pressures in military aircraft. In addition to the software development, BRC reviewed and organized the Government furnished data from a series of manned rapid decompression known as the EONS Experiments. The data from approximately 170 experimental decompressions were screened for their suitability for use in parameter selection and validation of the respiratory modeling software. DTIC

N95-10918 Naval Health Research Center, San Diego, CA. **FIRST DEMONSTRATION OF AN ALERTNESS MONITORING MANAGEMENT SYSTEM**

S. MAKEIG, F. S. ELLIOTT, and M. POSTAL 1994 22 p Limited Reproducibility: More than 20% of this document may be

affected by microfiche quality

(AD-A280858; NHRC-93-36) Avail: Issuing Activity (Defense Technical Information Center (DTIC))

The increasing speed and complexity of current information technology make it possible for computerized information systems to monitor the physical environment with increasing acuity. However, the capacity of the human operator or decision maker to maintain alertness to this information is not increasing, and relatively little effort has been invested in designing technology to enhance operators' abilities to maintain alertness. Despite common assumptions that while we are awake our alertness to the environment is secure and unbroken, many years of vigilance research attests that for most or all monitoring equipment operators (e.g., air traffic control, sonar, radar), maintaining a constant level of alertness is rare, if not impossible. Yet, no system currently exists that can monitor an operator's level of alertness directly, deliver timely information about lapses in alertness to the operator and/or supervisor, and initiate appropriate countermeasures. DTIC

N95-11195* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.

FINITE ELEMENT ANALYSIS OF A COMPOSITE WHEELCHAIR WHEEL DESIGN

RENE ORTEGA Washington Aug. 1994 32 p (NASA-TM-108463; NAS 1.15:108463) Avail: CASI HC A03/ MF A01

The finite element analysis of a composite wheelchair wheel design is presented. The design is the result of a technology utilization request. The designer's intent is to soften the riding feeling by incorporating a mechanism attaching the wheel rim to the spokes that would allow considerable deflection upon compressive loads. A finite element analysis was conducted to verify proper structural function. Displacement and stress results are presented and conclusions are provided. Author

N95-11326 Air Force Inst. of Tech., Wright-Patterson AFB, OH. **IMPLICATIONS OF OBJECT VERSUS SPACE BASED THEORIES OF ATTENTION IN THE DESIGN OF THE AIRCRAFT HEAD-UP DISPLAY M.S. Thesis**

JEFFRY LONG (Illinois Univ., Urbana-Champaign, IL.) 1994 51 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality

(AD-A281791; AFIT/CI/CIA-94-062) Avail: CASI HC A04

Thirty-two pilots flew instrument approaches in a high-fidelity simulator. Location of flight symbology was manipulated head-up vs. head-down while controlling for optical distance and symbology format. Pilots were assigned to one of two symbology sets, conformal or non-conformal. Each pilot flew half of the trials with the symbology presented in a head-up location and half with the symbology located head-down. An unexpected far domain event was presented on one trial per pilot. The results revealed that, for flight path control, there was generally a cost associated with head-down location. The magnitude of this cost was larger for conformal than for non-conformal symbology. Head-up presentation resulted in faster transition from instrument to visual flight reference, but slower response to the far domain unexpected event and greater error tracking digital airspeed. The results are interpreted with the theoretical framework of object-based and space-based theories of visual attention. DTIC

N95-11357 Biodynamic Research Corp., San Antonio, TX. **MODELING RESPIRATORY GAS DYNAMICS IN THE AVIATOR'S BREATHING SYSTEM, VOLUME 2 Final Technical Report, May - Dec. 1993**

JOHN B. BOMAR, JR., MICHAEL W. SCOTT, and DARRIN A. SMITH May 1994 413 p Limited Reproducibility: More than 20% of this document may be affected by microfiche quality (Contract F41624-93-C-6009)

(AD-A281932; AL/CF-TR-1994-0047-VOL-2) Avail: CASI HC A18

Biodynamic Research Corporation (BRC) completed an SBIR Phase 1 project to study the feasibility of developing a model of the

Aviator's Breathing System (ABS). The motivation for the project was the desire to develop a model which could simulate the cardiovascular and respiratory responses to altitude and acceleration stress encountered in high performance military aircraft. Software modules were developed and tested for simulation of: (1) the flows and pressures within the breathing gas delivery system; (2) the flows, pressures, and gas distribution within the lung; and (3) the steady-state flows and pressures within the cardiovascular system. Subprograms were also developed to compute altitude barometric pressure relationships as well as passenger cabin pressures in military aircraft. In addition to the software development, BRC reviewed and organized the Government furnished data from a series of manned rapid decompression known as the EONS Experiments. DTIC

N95-11386* Lamar Univ., Beaumont, TX. Coll. of Engineering. **ADVANCED SUPPORT SYSTEMS DEVELOPMENT AND SUPPORTING TECHNOLOGIES FOR CONTROLLED ECOLOGICAL LIFE SUPPORT SYSTEMS (CELSS) Final Technical Report, Sep. 1992 - Aug. 1994**

WILLIAM E. SIMON, KU-YEN LI, CARL L. YAWS, HARRY T. MEI, VINH D. NGUYEN, and HSING-WEI CHU 31 Aug. 1994 95 p (Contracts NAG9-620; NAG9-640) (NASA-CR-196774; NAS 1.26:196774) Avail: CASI HC A05/MF A01

A methyl acetate reactor was developed to perform a subscale kinetic investigation in the design and optimization of a full-scale metabolic simulator for long term testing of life support systems. Other tasks in support of the closed ecological life support system test program included: (1) heating, ventilation and air conditioning analysis of a variable pressure growth chamber, (2) experimental design for statistical analysis of plant crops, (3) resource recovery for closed life support systems, and (4) development of data acquisition software for automating an environmental growth chamber. CASI

N95-11394* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.

PORTABLE SEAT LIFT Patent

BRUCE WEDDENDORF, inventor (to NASA) 2 Aug. 1994 7 p Filed 2 Nov. 1992 Supersedes N93-17045 (31 - 5, p 1228) (NASA-CASE-MFS-28610-1; US-PATENT-5,333,931; US-PATENT-APPL-SN-970203; US-PATENT-CLASS-297-334; US-PATENT-CLASS-247-330; US-PATENT-CLASS-247-DIG.10; INT-PATENT-CLASS-A47L-1/00) Avail: US Patent and Trademark Office

A portable seat lift that can help individuals either (1) lower themselves to a sitting position or (2) raise themselves to a standing position is presented. The portable seat lift consists of a seat mounted on a base with two levers, which are powered by a drive unit. Official Gazette of the U.S. Patent and Trademark Office

N95-11600 McGill Univ., Montreal (Quebec). Centre for Northern Studies and Research.

SECOND INTERNATIONAL DESIGN FOR EXTREME ENVIRONMENT ASSEMBLY (IDEEA TWO). GROWTH AND ENVIRONMENT; CHALLENGING EXTREME FRONTIERS

1994 708 p Conference held in Montreal, Quebec, 24-27 Oct. 1993

(ISBN-0-7717-0267-1) Copyright Avail: Issuing Activity (Centre for Northern Studies and Research, McGill Univ., 805 Sherbrooke Street West, Montreal, Quebec, H3A 2K6, Canada)

The proceedings of the second annual International Design for Extreme Environment Assembly (IDEEA) include keynote addresses, panel discussions, and technical papers related to different types of extreme environments. Topics covered at the conference include: space structures; construction and architectural design for the Antarctic; a new encasement for block 4 of the Chernobyl nuclear power plant; human factors in space, design for extreme environments; underground as an extreme environment; biospherics; human factors; planetary exploration; energy systems and infrastructures; transport, mining and resources; international lunar

systems workshop; environmental protection; earthquakes; international Mars mission workshop; sustainable development; institutional approaches: the IDEEA Federation; urban planning; and new media technology for environmental scientists.

N95-11601 Institute of Traditional Studies, Auckland (New Zealand). **THE INDIVIDUAL INTEGRAL SPACE HABITATION: PRELIMINARY SKETCH DESIGN OF AN INDIVIDUAL TENSILE SPACE HABITATION, SITUATED WITHIN A LARGE-SCALE CENTRALISED TENSILE LATTICE STRUCTURED PNEUMATIC ENCLOSURE, IN MICROGRAVITATIONAL SPACE**

ROBERT C. MEURANT In McGill Univ., Second International Design for Extreme Environment Assembly (IDEEA Two). Growth and Environment: Challenging Extreme Frontiers p 8-15 1994 Copyright Avail: Issuing Activity (Centre for Northern Studies and Research, McGill Univ., 805 Sherbrooke Street West, Montreal, Quebec, H3A 2K6, Canada)

Elsewhere I present proposals for very large-scale mega-structures in microgravity, to provide a habitable environment for the future colonization of Space. A centralized primary tensile lattice of seven miles diameter is tensed by an enveloping pneumatic enclosure, which provides insulation and protection from the vacuum of space, radiation, micrometeorite impact, etc. Thus the necessary habitable atmosphere stresses the entire assemblage. The lattice geometry is that of the centralized zonahedral mandalas discovered by the author. Secondary pneumatic enclosures are developed in zonahedral cells within the primary lattice, and provide large-scale local open spaces, with internal surfaces comprising space habitation neighborhoods. Secondary tensile assemblages are stressed by means of primary tensile lattice, and provide local structures as needed. Subordinate tensile assemblages are configured as desired, the entire structural system enabling a 'soft' non-rigid tensile architecture to be developed which exploits the microgravitational environment of Space. This paper presents sketch design proposals for one such subordinate tensile assemblage - an individual tensile space habitation, designed to be located within the context of one such mega-structure. Thus the individual dwelling is surrounded by secondary tensile elements, which provide radial stressing about the entire perimeter as needed. A habitable atmosphere is presumed, as is the provision of services and communications. The individual dwelling is detached from other dwellings. Modelling of the Space Habitation has been greatly facilitated by the element Xometool 31-Zone Structural System kindly made available by Marc Pelletier of BioCrystal Inc. The mock-up uses 60 outer and 21 inner long red pentagonal struts and 32 outer and 6 inner nodes of the Xometool kit. I am particularly interested in exploring notions of dwelling in microgravity, and suggesting a tensile architecture that is highly economic, whilst providing for spiritual, psychological and material needs of the dwelling assemblage. The individual Integral Space Habitation encapsulates these ideas. Author

N95-11602 Energia Nucleare e Delle Energie Alternative, Bologna (Italy). Progetto Antartide.

CONCORDIA STATION

ANTONINO CUCINOTTA, PATRICE GODON, and UMBERTO PONZO In McGill Univ., Second International Design for Extreme Environment Assembly (IDEEA Two). Growth and Environment: Challenging Extreme Frontiers p 17-36 1994

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The cooperation agreement, between the IFRTF (Institute Français pour la Recherche et la Technologie Polaires) and the PNRA (Programma Nazionale di Ricerche in Antartide) the Italian Antarctic Project, has the aim of building a permanent station on the Antarctic Plateau for a program of scientific and technological research. Author

N95-11603 Tasmania Univ., Hobart (Australia). Inst. of Antarctic and Southern Ocean Studies.

HABITABILITY OF AUSTRALIAN ANTARCTIC STATIONS

LISA NELSON *In* McGill Univ., Second International Design for Extreme Environment Assembly (IDEEA Two). Growth and Environment: Challenging Extreme Frontiers p 37-45 1994 Sponsored by Australian Antarctic Science Advisory Committee Copyright Avail: Issuing Activity (Centre for Northern Studies and Research, McGill Univ., 805 Sherbrooke Street West, Montreal, Quebec, H3A 2K6, Canada)

It has been well recognized that living in an extreme and remote environment, under isolated and confirmed conditions, can have a significant impact on the psychological well-being. The effect of these conditions on people living on small Antarctic research stations has been documented in psychological studies conducted over the past 35 years, being the period of permanent occupation of Antarctica. Most common amongst the physical and psychological symptoms are depression, irritability, withdrawal, sleep disturbance, cognitive and sensory impairment. So common are these symptoms that they have been labelled 'winter-over syndrome'. Recognizing the potential negative impact on station productivity and efficiency the designers of the newly rebuilt Australian Antarctic Stations aimed to use the built environment to enhance the living and working conditions of expeditioners. Habitability principles were applied with the aim of creating a place where people can 'thrive and not just survive'. Features which give individuals privacy whilst encouraging social cohesiveness, provide sensory and spatial variation and connect the interior and exterior environments were included in the design of the new stations. A project assessing the success of these designs is currently being conducted at the three Australian Antarctic Stations. This paper will outline the methodology of this five year project, based on questionnaires, interviews and observational studies and report preliminary data from the first two years of the study. Author

N95-11604 Academy of Sciences (USSR), Moscow (USSR). Committee on Antarctic Research.

ARCHITECTURAL CONCEPT OF ANTARCTIC STATION OF A NEW GENERATION

ARKADIY S. SHEINSTEIN, VLADIMIR M. KOTLYAKOV, VLADIMIR I. BARDIN, ALEXANDER R. ASADOV, and NATALIE V. KRULOVA *In* McGill Univ., Second International Design for Extreme Environment Assembly (IDEEA Two). Growth and Environment: Challenging Extreme Frontiers p 53-56 1994 Copyright Avail: Issuing Activity (Centre for Northern Studies and Research, McGill Univ., 805 Sherbrooke Street West, Montreal, Quebec, H3A 2K6, Canada)

The paper describes the architectural concept of the antarctic station based on utilization of advanced technologies. Special emphasis has been laid on the use of energy-saving technologies. The concept has been worked out in the framework of the joint program between Russian Committee on Antarctic Research, IDEEA Russia and Moscow Institute of Architects. Author

N95-11609 Embry-Riddle Aeronautical Univ., Daytona Beach, FL. **INTERIOR DESIGN FOR INTERNATIONAL TEAMS SERVING LONG TERM IN AN EXTREME ENVIRONMENT: A PROBLEM STATEMENT**

MARYLIN K. SHEDDAN *In* McGill Univ., Second International Design for Extreme Environment Assembly (IDEEA Two). Growth and Environment: Challenging Extreme Frontiers p 231-241 1994 Copyright Avail: Issuing Activity (Centre for Northern Studies and Research, McGill Univ., 805 Sherbrooke Street West, Montreal, Quebec, H3A 2K6, Canada)

Technical issues such as radiation hardening, oxygen supply redundancy, and other technological safeguards we can develop will be useless unless people are able to function effectively, both individually and as team members. This paper explores the requirements for some semblance of 'comfort level' in habitats in extreme environments — particularly outer space and the moon — and, more important, what issues of acculturation must be addressed to ensure

that the habitat functions as viably as possible when used by an international team. This paper is a 'Problem Statement' that introduces design and, therefore, policy issues which need to be addressed regarding international teams doing long-term exploration and settlement. Elements considered include determining the human issues related to closed-loop environments (e.g. personal space, noise, cooking and eating facilities, ambient temperatures); issues related to internal and external communications; consideration of emergency response methods and ethics, recycling, and related concerns. In addition to describing a group of issues which must be addressed, the paper briefly assess various cultures already involved in the space program and their effect on the design of space facilities. It looks at questions of gender mix, ages, and possible crew and settler selection criteria for the future. It focuses on specific interior design issues relevant to the presence of an international team in the space environment to extended periods (six months to five years). Author

N95-11610 Colorado School of Mines, Golden, CO. Center for Space Mining.

USE OF THE UNDERGROUND FOR EXTREME ENVIRONMENTS

RUSSELL J. MILLER *In* McGill Univ., Second International Design for Extreme Environment Assembly (IDEEA Two). Growth and Environment: Challenging Extreme Frontiers p 275-279 1994 Copyright Avail: Issuing Activity (Centre for Northern Studies and Research, McGill Univ., 805 Sherbrooke Street West, Montreal, Quebec, H3A 2K6, Canada)

While the underground has often been considered an extreme environment, it also can be considered as a solution in many extreme environments. Underground space offers natural protection from those elements that define and extreme environment - factors such as: weather, temperature extremes and temperature variations, radiation, surface traffic, sabotage, or accidental damage. There are certain types of information required for any potential underground project, with additional considerations for extreme environments. As an example of the use of the underground in an extreme environment, we will look at space, and in particular the moon, to identify requirements, constraints, and concepts that should at least define the limits for the application of underground space in other environments. Author

N95-11611 Minnesota Univ., Minneapolis, MN. Underground Space Center.

AN OVERVIEW OF UNDERGROUND SPACE AS AN EXTREME ENVIRONMENT

JOHN CARMODY *In* McGill Univ., Second International Design for Extreme Environment Assembly (IDEEA Two). Growth and Environment: Challenging Extreme Frontiers p 287-290 1994 Copyright Avail: Issuing Activity (Centre for Northern Studies and Research, McGill Univ., 805 Sherbrooke Street West, Montreal, Quebec, H3A 2K6, Canada)

Underground space represents an extreme environment in a number of ways. Hazardous and difficult work conditions are found in mining and tunnelling activities, and when underground facilities are occupied, psychological and life safety concerns must be addressed. This paper presents a general overview of underground space as an extreme environment. It is in three sections: (1) background, (2) human factors in underground space, and (3) relevance to other extreme environments. Author

N95-11615 Florence Univ. (Italy). Coll. of Architecture. **MOON BASE HABITABILITY ASPECTS: PERMANENT MOON OUTPOST Abstract Only**

MASSIMILIANO LEONCINI *In* McGill Univ., Second International Design for Extreme Environment Assembly (IDEEA Two). Growth and Environment: Challenging Extreme Frontiers p 338 1994 Copyright Avail: Issuing Activity (Centre for Northern Studies and Research, McGill Univ., 805 Sherbrooke Street West, Montreal, Quebec, H3A 2K6, Canada)

To live in a confined, small habitat for a prolonged space

mission may cause very harmful psychological and sociological problems affecting both productivity and mission objectives. Like on Earth similar situations, (boats, caravans, trains, submarines, etc.) the architecture may solve these very critical aspects of early space mission. The principal main negative characteristics resulting from the lack of space in a HABITATION module are: (1) too many functions to be satisfied in the same volume, and (2) too limited volumes dedicated to each function, (3) too limited off-duty volume, (4) crowded volumes, and (5) lack of spaciousness. This has direct impact on human perception and behavior causing: claustrophobic effects, lack of environmental stimuli, proxemics problems deriving from crowded operational, and volumes, including internal flow difficulties. A new approach to MOON BASE HAB-LAB, module design is necessary. The development of a new architectural design project is possible in the following requirement are taken into account: variety of environments in terms of volumetric variable shapes obtained with flexible architectural and functional elements, variety of environment in terms of aesthetics & items utilization, and availability of a larger common volume to allow meetings of the entire crew, and to improve social relations, availability, when it is necessary, of semi-private zones for two/three crew members, medical support area improvement with the creation of a complete isolated cabin for quarantine cases, and two-levels working areas. As a result the guidelines of the interior design of the Habitation Module are: (1) flexibility of internal configuration to favor-crew shift and schedule variations, (2) facility of adaptation and modification of internal architectural configuration for future different moon base requirements, (3) privacy for private activities and facilitation of crew communal activities, (4) variation of volumes, shapes and dimensions to articulate inner space and to stimulate human asymmetry perceptio, (5) variations of visual stimuli through colors, texture and lighting, and (6) respect of the rules of spatial habitability as regards to visual and kinaesthetic aspects and social logic. Author

N95-11616 Galofaro (Luca), Rome (Italy).

HABITAT FOR SHORT DURATION LUNAR MISSION

LUCA GALOFARO and LUCIAN LEONTE In McGill Univ., Second International Design for Extreme Environment Assembly (IDEA Two). Growth and Environment: Challenging Extreme Frontiers p 339-344 1994

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A scientific type of Lunar mission requires the accommodation of a crew that will perform EVA activities as well as indoors experiments. The mission data is: Shuttle cargo bay used for transportation to rendezvous with lander in LEO, far side equatorial location, 60 days duration of stay, 4/5 persons crew, 6 hours of EVA for 2 persons changing every other day. The design process has been initiated from identifying two basic requirements; the transportation of the habitat from earth to the lunar surface should be economical, the quality of living inside the habitat should support the physical and psychological conditions of the crew during the mission. The two aspects come in conflict from mass-volume consideration. This approach has led to the concept of a 4.5 m diameter cylinder that will be landed on location on the lunar surface and then will automatically deploy a 3.5 m diameter inner cylinder along its axis. This contains all the hardware, racks, airlock and solar storm shelter while the remaining hollow cylinder will constitute the living space being provided with semi-rigid deployable furniture.

Author

N95-11618 Alaska Univ., Anchorage, AK. Dept. of Civil Engineering.

SELECTION OF SANITATION ALTERNATIVES: A STRATEGY FOR REMOTE ALASKAN COMMUNITIES

JOHN A. OLOFSSON and LAWRENCE A. IWAMOTO In McGill Univ., Second International Design for Extreme Environment Assembly (IDEA Two). Growth and Environment: Challenging Extreme Frontiers p 365-374 1994

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Research, McGill Univ., 805 Sherbrooke Street West, Montreal, Quebec, H3A 2K6, Canada)

A conceptual model is presented to guide selection of appropriate disposal systems for rural Alaskan communities. Author

N95-11623 Krug Life Sciences, Inc., Houston, TX.

INTERDISCIPLINARY AIR AND WATER ASPECTS OF CLOSURE OF SPACE LIFE SUPPORT SYSTEMS

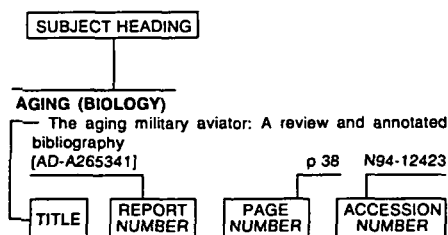
CRAIG E. LITTON and WILLIAM J. CRUMP In McGill Univ., Second International Design for Extreme Environment Assembly (IDEA Two). Growth and Environment: Challenging Extreme Frontiers p 426-436 1994

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Interdisciplinary issues are reviewed from work on closed environments, Sick Building Syndrome (SBS) and data from NASA's Water Recovery Test. Advanced biological/physical/technological interface systems design will require cooperative research in several science disciplines. Basic scientific issues include contamination control (trace volatile organics), microbial management, and passive biocides (iodine). Technological development issues include the uncertainty in closed biological systems (human variability, multiple gas streams, liquids, solids), required information management/control, and the Physical-Chemical/Biological (PC/B) interface. Research in different testbeds, including those studying water regeneration indicate the limits of flexibility in PC systems response to biological challenge. These demands will drive engineering design of 'appropriate technology' - practical designs, capable of being tested within space flight constraints (launch weight, consumables, power, reliability, maintainability, and ability to withstand launch, microgravity and radiation). The applied challenge will be to develop designs which can be supported, augmented, and replicated with Lunar/Mars materials. To create air-tight, long-use facilities, designs must meet challenges similar to the health effects of SBS. Although many earthbound contributors to SBS are, and will not be, present in space systems, future habitats will face complex pressures from recycling systems, trace contaminants, and inherent microflora. We reviewed LSS closure work and SBS studies. The analogies between these two will become more apparent as extended-duration spaceflight becomes routine. Flight crews will find themselves in the 'tightest' of 'tight-buildings'. Live-in/ground-based tests of such systems are necessary before launch. Total system integration testing cannot be replaced by paper studies or math models, especially at the biology/engineering interface.

Author

Typical Subject Index Listing



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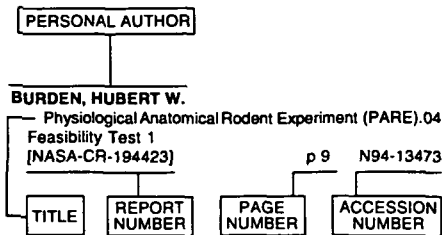
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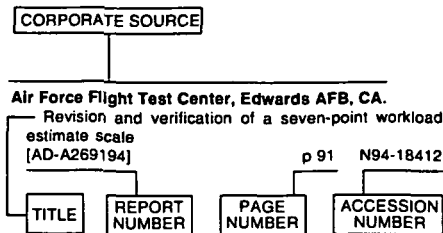
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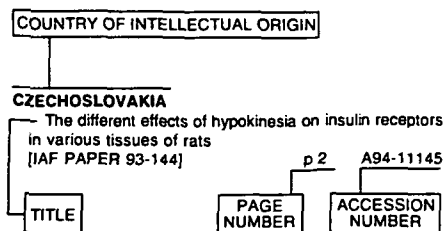
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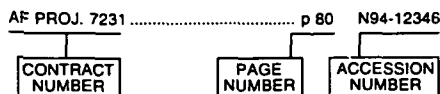
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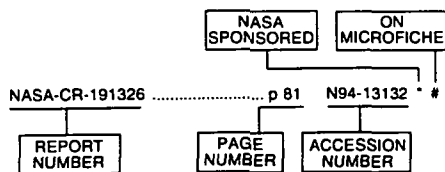
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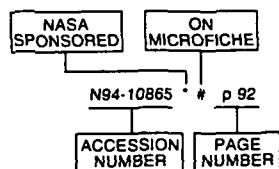
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